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ABSTRACT

Unesco is playing an increasingly important role in helping developing countries adapt school furniture in line with educational methods and goals. This publication includes an independent evaluation of Unesco's school furniture projects in Sri Lanka and Tunisia. For purposes of comparison, evaluation of a furniture project carried out by the Department of Education and Science in the United Kingdom is also included. (Author/MLF)

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School Furniture Development: An Evaluation

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An Evaluation

by

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Preface

The last five years have seen a growing worldwide concern with changes in traditional teaching methods - formal teaching is giving way to informal, so-called "active" methods where students spend less time being lectured to in large groups and more time in small group project work and independent study. In many countries this evolution is being hindered by outmoded school furniture. The traditional classroom situation calls for a podium to elevate the professor over his charges, and seating arrangements to ensure a minimum of movement on the part of students. With the new teaching methods, however, it is assumed that students will move about the classroom frequently and with ease. Thus, the traditional "table-banc" - a cumbersome desk and seat unit accommodating two students - is giving way to individual chairs and tables which can either serve one or two students or be grouped to serve four or six. Furthermore, new teaching methods underline how necessary it is to develop a wider range of furniture. Traditionally, teaching spaces were wholly taken up by a teacher's desk, a small segment of chalk board, and student seating. The need now is for more chalk board, abundant display space, moveable trolleys with special purpose materials (library books or animal cages for example) and an abundance of different types of storage.

Unesco is playing an increasingly important rôle in helping developing countries adapt school furniture in line with educational methods and goals. The present publication includes an independent evaluation of two of the Organization's projects along with a review of a similar, but far more ambitious project in a European country. The reader will quickly come to see that the designing and construction of furniture is no simple matter. They imply expert knowledge in many specialized areas of concern ranging from the study of furniture size in relation to the physical characteristics and needs of children, to the proper selection of glues and inspection of welded joints. The reader may also be surprised by the critical nature of the evaluations themselves. In fact these evaluations are being published and distributed so that Member States can benefit from the oversights and misfortunes of others. For its own part, Unesco has learned a great deal from them, in particular that it is better to concentrate limited funds on research and development of excellent chairs and desks for students rather than to spread these resources over the gamut of furniture required in a school. Member States, on the other hand, should recognize that any piece of furniture needs to be built exactly as it was designed and that any deviation from the original design makes careful testing in a "live" classroom situation inevitable.

Partially as a result of this evaluation, Unesco is aware of the need to improve the quality of its services to Member States in what is a specialized, yet highly important field. As a first step towards satisfying this need, it has embarked on a substantial study on how to go about planning and designing for furniture production on a large scale, but with the maximum use of local skills and materials.

Since it will be some time before the over-all results of this study are complete and available, it has been decided to publish and distribute these evaluations now. It is hoped that they will be of particular value to educational planners and administrators at all levels, but especially useful to those who are responsible for the purchase, distribution and maintenance of school furniture. At the same time, they should prove of value to furniture designers and manufacturers.

The evaluations have been undertaken by F.B. Scriven and Associates, a firm of educational facilities planning consultants in London. Mr. Scriven is the author of Sports facilities for schools in developing countries, No. 8 in the Unesco series Educational Studies and Documents.

In addition, he has undertaken advisory missions for Unesco to Africa, Asia and the Arab States, two of which have specifically involved him in furniture design. His associates on this study have worked on the research and development of furniture in Europe.

The views put forward in this publication are those of the authors and are not necessarily an expression of Unesco's policies in the area under study.

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Introduction

In all, Unesco has been involved in school furniture projects in some fifteen countries, Project assessments have taken place in the case of work in Algeria, India, Iran, Sri Lanka and Tunisia, and evaluations of the Sri Lanka and Tunisian projects are contained in the present study. For purposes of comparison, evaluation of a furniture project carried out by the Department of Education and Science in the United Kingdom is also included.

At the outset, it should be remarked that the three projects under consideration differ widely in nature. In the case of the Tunisian project, a furniture designer recruited by Unesco helped with the design of furniture for three secondary schools. In the Sri Lanka project, the Asian Regional Institute for School Building Research (ARISBR) identified a problem at national level, asked the government if it could find a solution to it, and then hired a furniture design consultant to help for a short period. As regards the United Kingdom, the Department of Education and Science was interested in promoting a more efficient relationship between Local Education Authorities and private furniture manufacturers and the project itself was on a much larger scale than in either the case of Tunisia or Sri Lanka.

As to the purpose of evaluation itself, it can be summed up as follows:

To estimate the effectiveness of Unesco's involvement in school furniture design so far. To point out the strengths and weaknesses of this involvement, and to make suggestions on any required changes in Unesco policy.

To provide a basis for the "School Furniture" study that will prove of practical use to those involved in all aspects of the provision of school furniture.

To provide information for furniture design groups engaged on projects in countries where conditions may be similar to those considered in the evaluations.

To form a basis for any further stages in, or development of, the evaluated projects.

It is worth pointing out that Unesco's involvement in school furniture is a direct response to requests from developing countries which have recently come to attach great importance to the question. In many developing areas traditional schools have no furniture. In the Koranic schools of the Muslim world, for example, children squat on carpets or reed mats. Nothing indicates that such squatting or sitting cross-legged is tiring, once one becomes accustomed to the position, or that it is bad for the posture, or health. Children often prefer to do things on the floor, even when furniture is provided, and one increasingly sees children on the floors in progressive Western primary schools. But the educational authorities of developing countries insist that schools be equipped with sit-up furniture, perhaps in an effort to break with the forms of the traditional school, or perhaps as part of a general process of Westernization.

There is little doubt that in terms of money spent and people involved, education is far and away the largest industry in developing countries.

School building accounts for a substantial part of this total investment and school furniture represents about 10 to 20 per cent of the cost of the school building. It is a situation in which construction has difficulty in keeping pace with enrolment targets set by the authorities and in which the furniture industry in turn finds it difficult to keep up with school construction.

As Unesco and informed sources in developing countries recognize, a problem of this size can only be solved by innovation. Difficulties cannot be done away with simply by importing ideas and techniques evolved for developed countries. Nor should furniture be viewed simply as "pieces of furniture"; it also needs to be thought of in a larger context as that essential element which fills the space between the user (teacher/

student) and the building. In short, solutions must be found to real, and not imagined, problems.

Unfortunately, Unesco consultants working on specific projects as part of furniture development teams in developing countries, do not always encounter a climate of opinion that permits problems to be analysed from first principles and solved logically; in other words, innovation is rendered unfeasible. If the final result looks too unconventional, the consultant may be asked to think again. In particular, there is often pressure to resist any innovation which does not already exist in developed countries.

In the light of these requests and problems, Unesco attempts to play two practical rôles in relation to school furniture.

On the one hand, it recruits consultants who are expert in areas where the developing countries cannot find specialists of their own. For the most part, the consultants chosen are designers. But since many projects have proven weak at the administrative and management levels, there is a temptation to send administrators. This is unjustified; competent administrators can be found in almost all developing countries. However, Unesco should satisfy itself that such administrators have been assigned to projects before a designer is appointed. If local conditions warrant it, of course, a case can be made for sending production engineers, or at least designers with a strong production bias, since this is a further area of weakness.

It should be remembered that a designer in these conditions is a member of a team. His function is that of a "resource person": to provide information and expertise in his speciality, while leaving policy matters to others. He may give advice to those who define policy, but he should never assume the rôle of leader.

Unesco's second rôle is to disseminate information and ideas for the benefit of policy makers in order that the correct climate of opinion may exist for innovation, when innovation is necessary. As already stated, these ideas should not be in the form of ready-made answers or formulae.

Up until now a weakness in Unesco's involvement in furniture projects has been the confusing of its two rôles. Resource people have been involved in unsolicited innovation and there has been either a failure to convey the need for innovation, or inability to do so in terms that can be understood by policy makers. Field projects tend to contain more radical changes than education authorities can digest, and propaganda puts too much emphasis on ready-made solutions, and not enough on a problem-solving approach to innovation.

In all cases where Unesco engages designers to work on furniture projects, the projects have been run by, and in most cases staffed by, nationals of the country concerned. The Unesco consultant has been there in a support capacity; his salary has been only a small part of the total funding of the project. Designers have never been attached to projects for more than a short time. Yet the projects are universally considered as Unesco projects and if they fail, they are considered as Unesco failures. Consequently, it should be made perfectly clear that Unesco is first and foremost appointing designers in a support capacity - to fill a gap in a developing country's expertise and to train someone in that country to fill this gap.

On the other hand, if conditions permit it, there is no reason why a designer should not run a project from start to finish. as in the United Kingdom example, but at present Unesco does not have sufficient funds to allow this.

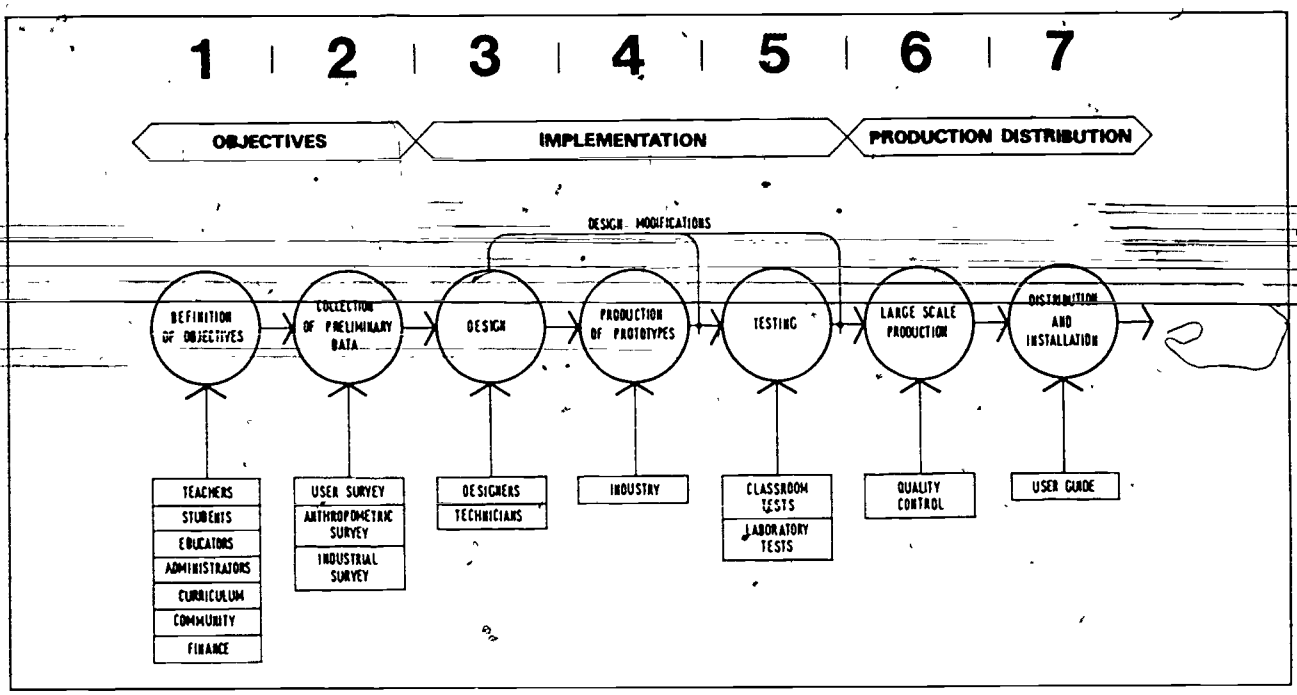
In the normal way, however, designers should not be involved in running projects. Nor should they be brought in at the start of a project. Furthermore, all preliminary groundwork and the definition of their work should be handled by the permanent staff of the project in the country concerned.

The Arisbr project in Sri Lanka provides an example of the latter kind of approach: the designer was in Sri Lanka for only six weeks and the preliminary groundwork and administration were undertaken by permanent Arisbr staff members. As it turned out though, six weeks was rather a short period and further visits by the designer would have been useful.

Once the practical stage has been reached, Unesco needs to ensure that projects are being run correctly. Specifically, it should see to it that the designer is prepared to start at the correct time. In this connexion, it would be worthwhile for the Organization to work out a standard method of approach to planning projects.

As a means of promoting the training of designers in developing countries and making the hiring of foreign consultants unnecessary, Unesco has favoured the "counterpart" - someone assigned to work with the designer and absorb his skills and expertise. However, it has been very difficult to find counterparts and many projects have been conducted without them or with inappropriate personnel. It has been assumed that a counterpart must form part of the permanent staff of the Ministry of Education, but it has often been difficult to find designers who also want to be full-time civil servants, Some flexibility is needed here, and projects could feature independent designers, or designers attached to manufacturers, as counterparts.

In addition, teaching should play a much larger rôle in those projects - not only insofar as designers are concerned but also in relation to



furniture users - teachers/students - and to furniture manufacturers. The consultant should seize every opportunity to address design and architectual students and speak at meetings and seminars. Indeed, this responsibility should be made an integral part of his contract. So far as material preparation is concerned, designers participating in projects take with them the information they have in their heads and, in terms of documents, what they can carry in a suitcase. But over and above this, consultants in the field should be served by an information back-up service at Unesco headquarters. In any event, Unesco sponsored projects that incorporate innovation or change, however slight - such as a change from combined tables and benches to separate tables and chairs or a lowering of the height of school furniture - should budget for time and manpower to disseminate these ideas to administrators and users of the furniture.

Many countries have either prevented school furniture imports altogether, or imposed restrictive tariffs in order to strengthen their own furniture industry. However, it should be possible to import a certain amount of school furniture - this amount need not exceed five per cent of requirements - so that both users and manufacturers have some means of comparing design and quality. The importation of furniture should be looked upon as a way of importing furniture technology and a means of preventing monopolies and cartels. Usually, the demand for school furniture in a developing country is so high that it is possible for manufacturers to sell all furniture produced, whatever the quality. The threat, and the example of a certain amount of importation, should enable quality to be kept up to standard.

Given the complexity of the question, it seems right that Unesco should have a policy of its own, in regard to school furniture - a set of guidelines that is more than the sum total of its members' policy.

Yet, as mentioned previously, the Organization's endeavours to promote innovations have met with only partial success. In this connexion, two projects come to mind: a multi-purpose furniture unit for schools and a Mobile Teaching Package. Both projects were imaginative, inexpensive solutions to real life problems. But neither was acceptable to the educational authorities in the two countries concerned.

To help reduce such difficulties, Unesco should have the means of diffusing its ideas and policy in order to encourage innovation. Such an initiative could be aimed at policy makers rather than technicians. The following suggestions are made to this end:

- The production of well-presented concise reports on significant projects and items of interest in developing or developed countries; these reports would cover the economic and educational aspect of projects, as well as the technical aspect. This information could be diffused in the form of a newsletter.
- Demonstration projects: the complete or partial financing of significant innovative projects, such as the multi-purpose furniture unit and the Mobile Teaching Package, that member countries consider too experimental to justify the investment of precious funds.

Broadly speaking, the common procedures in school furniture research and development projects may be set out in seven steps: (1) Definition of objectives; (2) Collection of preliminary data; (3) Design; (4) Production of prototypes; (5) Testing; (6) Large-scale production; (7) Distribution and Installation.

Inputs of information and expertise are, of course, required at various points during this process. These are summarized in the diagram page 9 where the steps are enclosed with circles and the inputs with rectangles. In addition, proper knowledge of the steps themselves calls for the more detailed analysis which follows.

1. Definition of objectives

What should be done? What is wrong with things as they are? What problems exist in relation to furniture? The definition of objectives requires contacts with teachers, students, educators, administrators and people in the local community, as well as a knowledge of the school curriculum and what funds are available.

2. Collection of preliminary data

How do children learn in school now; how will they learn in the future? What is the physical stature of students? This may entail an anthropometric survey of the school population. What is the structure of the furniture industry, what manufacturing techniques are used and what materials are available for furniture production?

3. Design

The design of items of furniture, based on the definition of objectives in (1) and using the data collected in (2). Designers and technicians are required at this stage. They may be employees of the client authority, designers attached to a manufacturer, or private designers.

4. Production of prototypes

The production of prototypes of the furniture designed in (3). An input of manufacturing experience is required at this stage to judge the constructional feasibility of the prototype furniture.

5. Testing

The testing of furniture in learning situations in schools; teachers and students will be involved in these tests. The testing of furniture under laboratory conditions to simulate several years of use under classroom conditions.

6. Large-scale production

Some form of quality control will be necessary at the production stage when it will prove more effective than at the moment of distribution. Defects are easier to spot and rectify during manufacture than when the furniture arrives at a school.

7. Distribution and installation

Users of furniture are often unaware of the arrangement possibilities of the furniture with which they are provided. All the layout possibilities may not be clear to them. For example, they may not realize that stackable furniture is stackable. A users' guide may be useful.

To carry out one part of the process successfully requires some knowledge of all the other parts. For example, in stage (7) - Distribution and installation - if the furniture has to be transported great distances over rough terrain this may influence stage (3) - Design - and tests in stage (5) might be included to see how the furniture stands up to buffeting in transit.

Ideally, all those involved in a project - teachers, educators, administrators, designers, technicians and manufacturers - should form a team to carry the process through from start to finish. If this is not possible, then at least one person, with a knowledge of all the steps in the process or prepared to acquire this knowledge, should see the job through from beginning to end. In the Tunisian project no one was available to follow the project through to the finish and the project suffered.

Generally, projects will suffer if steps are left out or only given token attention. In the Sri Lanka project there was no quality control during manufacture or when the furniture arrived at the schools. In the Tunisian project the testing step was left out altogether.

Also, too much importance can be given to the fit of furniture, resulting in a large range of sizes - five in many cases. This is more than most educational authorities are able to handle administratively. In practice, the range is often cut to three or, as in the case of Sri Lanka, to two.

Consultants should bear in mind that industrial conditions are different in developing countries. Although the quality of management and of the work force may be high, various factors make industry slow to adapt to change. The second-hand machinery market is small or non-existent and if changes in furniture models make a machine redundant, it may simply have to be abandoned. All but the simplest machines must be imported and it is difficult to buy machines at a distance. Import formalities may be complicated and lengthy.

A large amount of materials and components may have to be imported, with the process rendered more difficult by possible import restrictions and interruptions in supply. Moreover, all of these factors make the introduction of change into the furniture industry in developing countries an extremely difficult undertaking.

Again, several well thought-out projects have foundered in the production stage owing to lack of skill, poor organization, inadequate materials or tools or a combination of these factors. Joint projects, or some form of co-operation with manufacturers right from the beginning of a project are recommended. Most problems that arise have either a design or a production solution; either the design can be changed to skirt the production problem or the production methods can be changed to overcome the design problem. In Sri Lanka it was found that wood screws rust and split the wood; either the screws can be replaced by nails (nails rust as well but because of their lower surface area they do not split the wood) or the screw manufacturers can be persuaded to produce rustless screws.

A standard method of writing a report on a school furniture project is suggested below:

(1) Two pages summarizing all the information detailed in (2) to (6) below, bringing out the salient points.

(2) Consultant's terms of reference as defined by Unesco, scope of the project.

(3) Consultant's work plan (to be submitted to Unesco at the start of the project). Schedule for the different stages of the project, such as:
- anthropometric study
- establishment of user requirements
- survey of available methods and materials
- design
- production
- quality control, testing
- administration of supply
- evaluation
- methods of communication

(4) Description of each stage of the work as detailed in (3) above.

(5) Recommendations for future action.

(6) Diary, brief description of daily events.

(7) Appendix containing details of work carried out, but which is not strictly necessary to the description under (4) above.

Case Study of a Project to Produce Standard Desks and Chairs for Schools in Sri Lanka

The Asian Regional Institute for School Building Research (ARISBR) was based in Colombo, Sri Lanka. In February 1973 its operations ceased. Those staff members who were Sri Lanka nationals stayed on at the ARISBR building in Colombo to form a purely Sri Lanka institute of school building research called AGOPA while Unesco staff members moved to Bangkok, Thailand, to become the Educational Facilities Section of the Regional Office for Education in Asia (ROEA).

The mission of ARISBR was to improve the design and reduce the cost of school buildings and equipment in the countries of the region. In pursuing this goal it relied on three main ways of diffusing its policy and the results of research throughout the region: experimental demonstration projects; residential seminars, and publications.

As part of its work, it helped focus attention on a school furniture problem encountered throughout Asia. The situation in Sri Lanka was, in fact, typical of that of many countries in the region. Existing desks and chairs were inadequate from an anthropometric point of view - they did not fit the children. Tables and chairs were generally too high. They were expensive, and their production required too large a range of costly operations. All joints were hand-made mortice and tenons, pegged without glue. Furthermore, the furniture was easily broken and difficult to repair.

DESIGNING AND ADOPTION OF THE PROTOTYPE

In 1968 Mr. Gammelgaard, a Danish furniture designer, was invited to come to Sri Lanka for six weeks to design a school desk and chair. Members of ARISBR laid the groundwork for his arrival by compiling anthropometric data on school children (published as ARISBR School Building Bulletin 15) and assembling information on furniture construction materials and methods as a basis for the design of the furniture.

As a result of the design exercise, the Sri Lanka Ministry of Education ordered 180 chairs and desks to be made in different varieties of wood and wood products. These were to be produced in the factories of the National Plywood Corporation and the prototypes were to be tested under classroom conditions.

The construction of the prototype furniture was simple; all joints were contact joints, glued and screwed. All timber was 2 cms thick throughout, widths were either 7.7 cms or 15 cms. The chair required only one-and-a-half hours to assemble, whereas the existing chair took five hours. The furniture was made in five sizes.

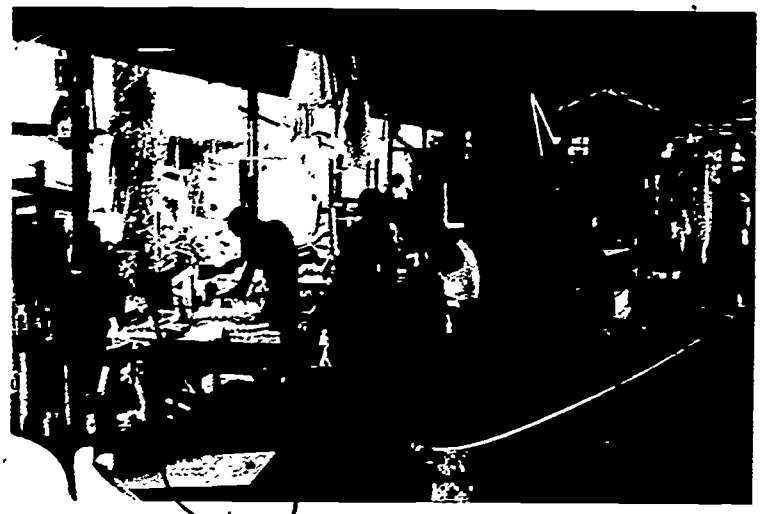
After a short period of testing under classroom conditions, certain minor structural modifications were made to the furniture, and the backrest of the chair, which was found to be uncomfortably low, was raised. However, the furniture was generally agreed to be successful and it stood up well under school conditions. It was therefore accepted for general use in schools by the Ministry of Education in December 1970.

PROBLEMS RESULTING FROM LARGE-SCALE PRODUCTION

In August 1973 when a visit to Sri Lanka was made in connexion with this case-study, a large amount of ARISBR furniture had been installed in the schools and more was being produced. But the change from prototype production to large-scale production had brought to light several problems.

The timber used in production is mainly unseasoned rubber wood; it is cheap and easily available in Sri Lanka. According to the National Plywood Corporation (the principal manufacturer of ARISBR furniture), the Ministry of Education is unwilling to pay the price of seasoned timber.

Plywood Corporation Factory, Colombo - sawmilling and furniture production



In Sri Lanka the air-drying of timber is quite a rapid process and it only takes from six to eight weeks to season timber to a satisfactory moisture content. But the National Plywood Corporation would add an additional 15 per cent to the price of furniture if seasoned timber were used.

On the other hand, unseasoned timber is hard to work, it makes it difficult to achieve a smooth finish. Moreover, shrinkage and distortion occur after the furniture item has been made. A high moisture content makes gluing difficult. Also, shrinkage after manufacture may loosen glued joints. In addition, the high moisture content rapidly rusts nails and screws.

Related difficulties further complicated matters at the production stage. The glue specified for the furniture is polyvinyl acetate (PVA) emulsion but the workmen failed to spread the glue properly and a number of joints failed when the unseasoned timber shrank. Worse still, the raw materials for PVA glue are imported and during production there was a break in supply when the glue was unobtainable. A full fifty per cent of all furniture seen, either in the schools or stocked after manufacture, had been made without glue. Furthermore, polyvinyl acetate (PVA) glue is not ideal for furniture, and under certain conditions certain types of PVA glue may produce unsatisfactory joints. In the United Kingdom, for example, the use of PVA glue has been banned for furniture in all central government contracts.

Again, workmen tended to treat screws as large nails, hammering them into place. The factories possessed no hand drills for making pilot holes, nor were there any power screwdrivers.

A combination of lack of glue and hammered screws was quite disastrous. The result was that there was as much broken ARISBR furniture in the schools, as there had been broken traditional furniture previously.

The prototype furniture was produced in five sizes, corresponding to five age ranges: B - 6 to 9; C - 9 to 12; D - 11 to 14; E - 13 to 16; F - 16 to adult.

But the Ministry of Education decided that it would be too complicated administratively to produce furniture in five sizes and the furniture was produced in two sizes only: size B for primary schools and size E for secondary schools. In this connexion, it is perhaps worth noting that existing furniture is also produced in two sizes. Be that as it may, the Ministry of Education has already received several complaints from both secondary and primary schools that the furniture is too low.

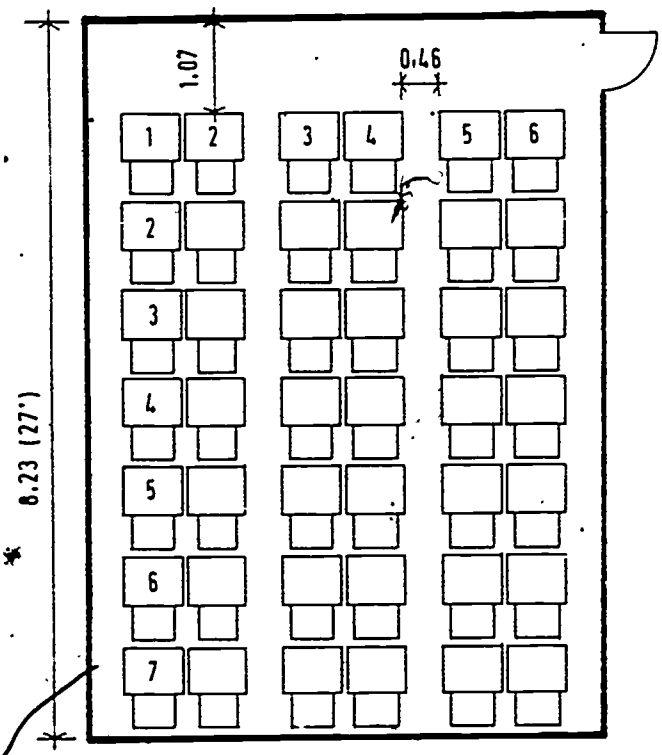
The minimum size of classroom in primary schools in Sri Lanka is 6.10 x 6.10 m (20' x 20');

Old and ARISBR furniture used together in one-classroom

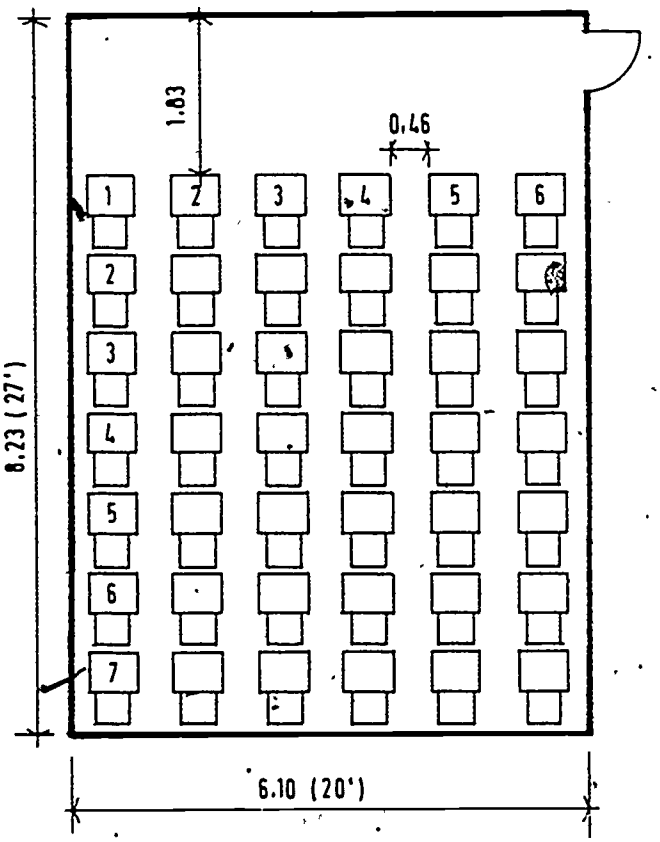
Cramped classroom conditions

Sri Lanka

Secondary School classroom
with ARISBR furniture



Secondary School classroom
with existing furniture



in secondary schools it is about 6.10 m x 8.23 m (20' x 27'). A large number of schools possess these minimum sized classrooms. The top of the old desks used in secondary schools measures 56 cm x 46 cm (22" x 18"), whereas the ARISBR desks for secondary schools measure 69 cm x 55 cm (27 1/2" x 21 3/4"). Previously, primary schools used tables for two, measuring 102 cm x 36 cm (40" x 14"), although in practice many primary schools were equipped with secondary school desks. The new ARISBR desks for primary schools measure 55 cm x 48 cm (21 3/4" x 18 1/2").

As can be seen from the sketch (page 15) depicting a secondary school classroom equipped with both the old and the ARISBR furniture, it is extremely difficult to put 42 ARISBR desks in a classroom measuring 6.10 m x 8.23 m (20' x 27'). Occasionally, as many as 45 children have to be accommodated. Clearly, the desks are no longer functioning as individual units and less formal classroom arrangements are almost totally ruled out.

Open-plan primary schools in country areas have an advantage in this respect. They consist of long undivided single storey buildings and are usually large enough to contain three or four classrooms. Such buildings allow a certain amount of flexibility in the arrangement of furniture. Using the ARISBR free-standing classroom divider, it is possible to arrange tables and chairs so that available space is used to best advantage.

THE CHAIR

This is a robust article based on a common folding chair prototype. In fact, the chair designed by Mr. Gammelgaard, along similar lines, for the Regional Educational Building Institute for Africa (REBIA) was also a folding chair.(1)

The ARISBR chair has been modified since its initial design in 1968. Originally, it featured a backrest at a height of 23 cm, but the present chair's backrest is 32 cm high. The backrest of the first chair was designed to support the lumbar vertebrae at the small of the back since research indicated the need to support this part of the spine in the interests of comfort. However, total comfort is lacking unless this support is curved or padded to accommodate a large part of the torso. Also where the backrest is a straight bar, it needs to be higher at the level of the thoracic vertebrae. Given that the spine is deeper in the back at this point, the weight of the body will be supported on the fleshy parts of the back instead of on the spine itself, as in the case of support at the level of the lumbar vertebrae.

The chair is designed so that it is difficult to rock backwards and forwards. A problem with the old chairs was that the joint between the back legs and the seat failed frequently. The ARISBR chair is extremely strong front to back, parallel with the triangles. The top joint is particularly strong - the area of contact is more than 70 sq cm with four screws. However, the joints at right angles to the triangles are less strong - contact only over 15 cm with two screws and these are the joints that fail most often. The photograph on page 17 shows an Indian pre-independence period school chair. It is triangulated in both directions; this could be an expensive solution. But it may be useful to turn the triangular members of the Gammelgaard chair through 90 degrees so that the traverse members can be fixed to the flat, instead of the edge of the triangle members, thereby increasing the contact surface of the joints to 56 sq cm and permitting four screws instead of two. The joint at the apex of the triangle would be weakened, but this is a relatively unimportant joint, and can be reduced to a simple pin joint, as in the folding version of this chair.

Another joint that fails frequently is the joint between the traverse members and the seat. This is because the screws fixing the seat have been driven in at right angles to the seat, and not at right angles to the traverse members, as shown on the drawings (see sketch page 18).

THE DESK

Like the chair, the desk is triangulated in one direction only, but since the traverse section at the top of the desk is much deeper and is screwed through to three thicknesses of timber at each end, the desk is stronger than the chair. The only structural failure seen on the desk, and this was rare, was a failure of the cantilever supporting the desk top, at the joint with the apex of the triangle. The City Timber Company, a private firm in Colombo, has been manufacturing the ARISBR desk with an extra member going from the end of the cantilever to the base of the triangle (see photograph on page 19). This makes for a sturdier desk. A fixed version of the folding 'scissors' type desk designed for REBIA by Mr. Gammelgaard would be more elegant than the City Timber Company desk and sturdier than the actual ARISBR desk.

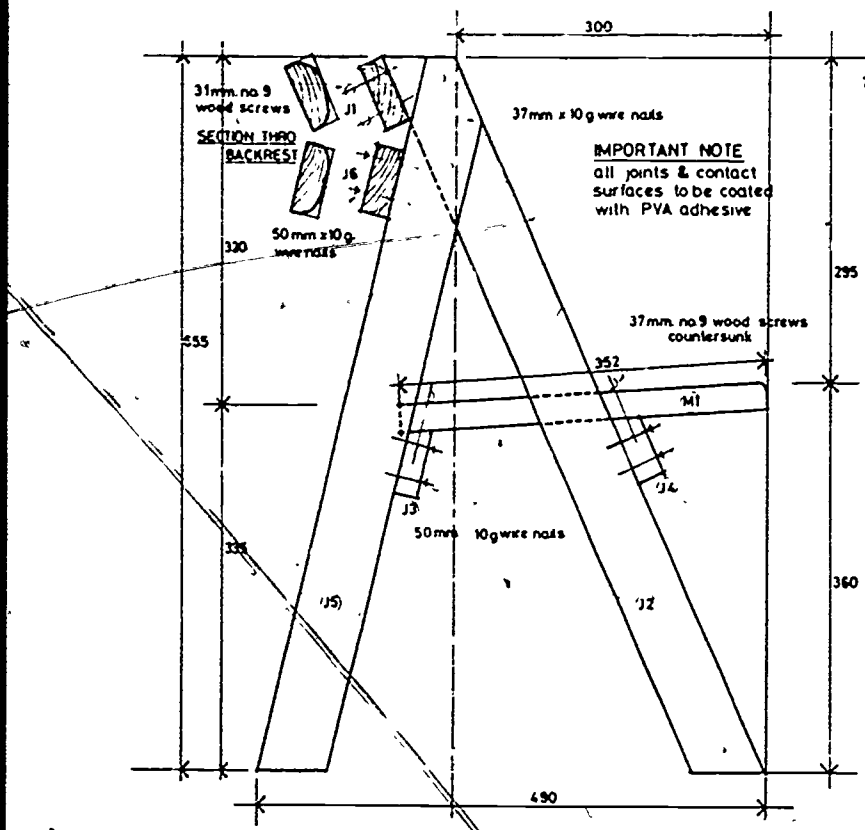
The main criticism brought against the desk in Sri Lanka is that it is too low. The B type desk, height 46 cm, is used for all primary school classrooms and the E type desk, height 61 cm, for all

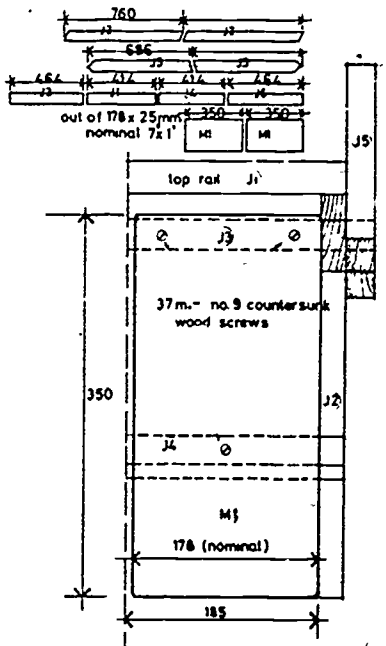
1. See the photograph on page 17 and the relevant description in the REBIA publication "Classroom furniture for Sudan Schools".

Indian pre-independance chair

REBIA folding chair and table

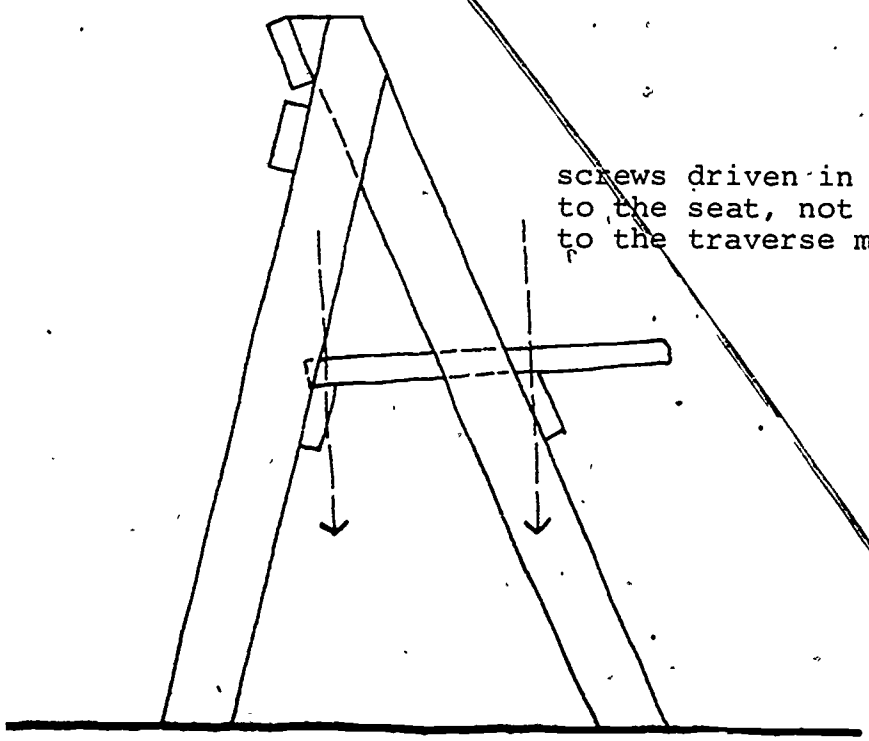
The pre-ARISBR table and chair, ARISBR's table and chair, revised AGOPA version



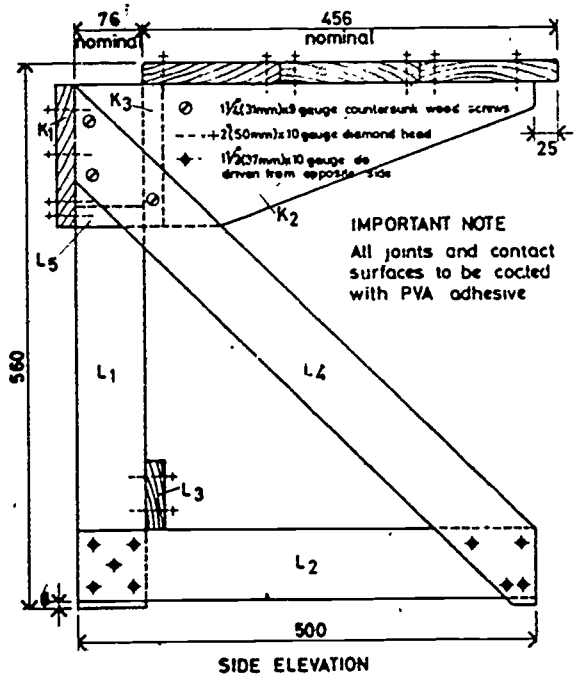


STUDENTS CHAIR TYPE ~ D

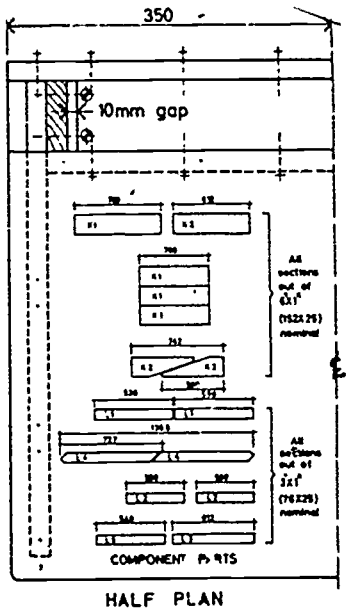
age group 11 - 14



screws driven in at right angles to the seat, not at right angles to the traverse members.



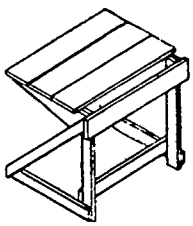
SIDE ELEVATION

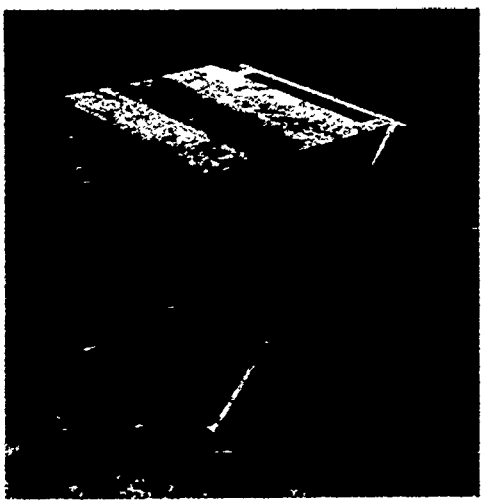


HALF PLAN

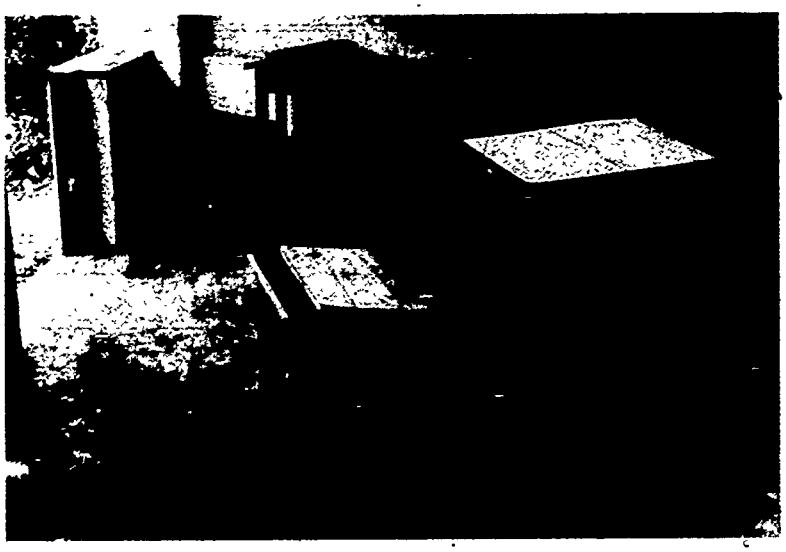
STUDENT DESK TYPE D (SINGLE)

Age group 11 - 14

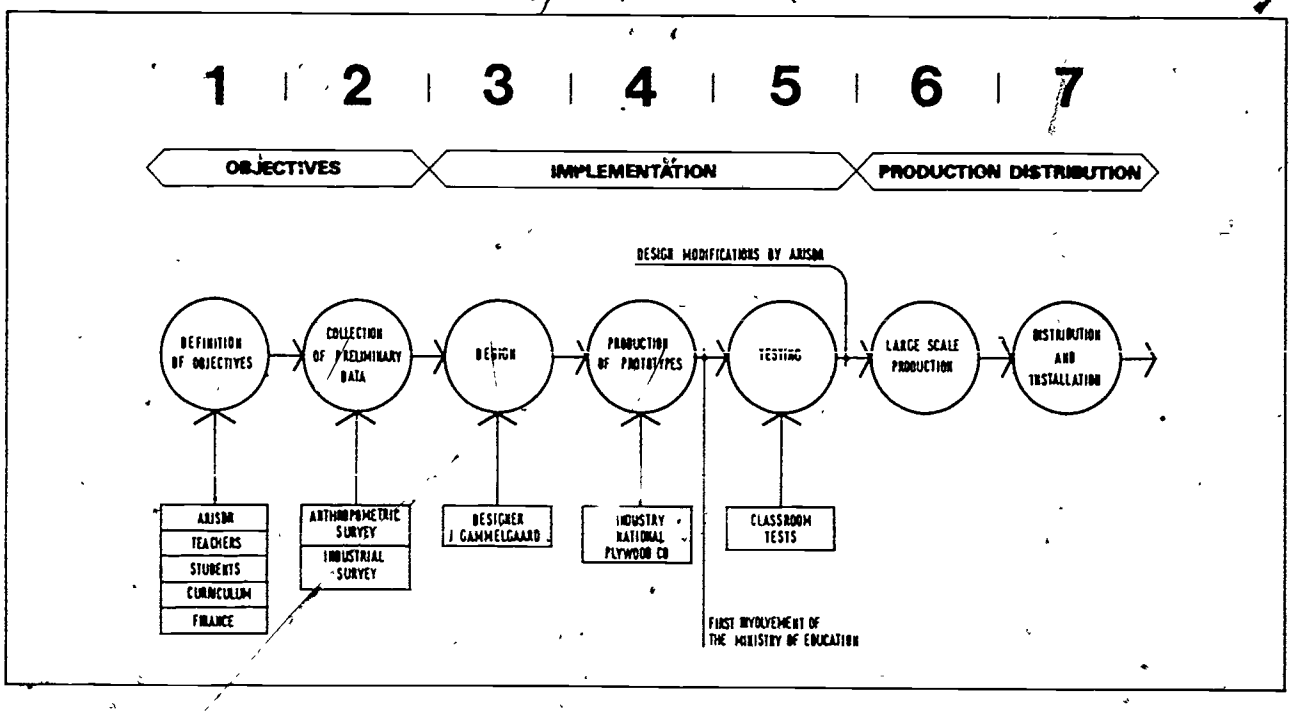




The City Timber Company's variation on the ARISBR desk



ARISBR size B desk being used as a seat



secondary school classrooms. It is recommended that the B type desk be used for all classrooms in secondary schools. Fitting trials carried out in actual classrooms should be conducted to verify that this choice of sizes works in practice.

The desk is also criticized for taking up too much classroom space. The book slot at the front of the desk adds an extra 10 cm to every desk top. The provision of locker storage for books elsewhere in the schools would make this slot unnecessary.

Because of school criticism of the ARISBR range of furniture, AGOPA was asked to redesign the desks, making the top both smaller (so that more desks could be fitted into classrooms) and higher (to meet complaints that the existing top was too low). AGOPA was engaged in this work during the case-study visit.

OVERVIEW

The development of this project is summarized in the diagram above. The process followed the pattern outlined in the summary of the steps typical of any school furniture research and development project (see page 9) but with certain differences.

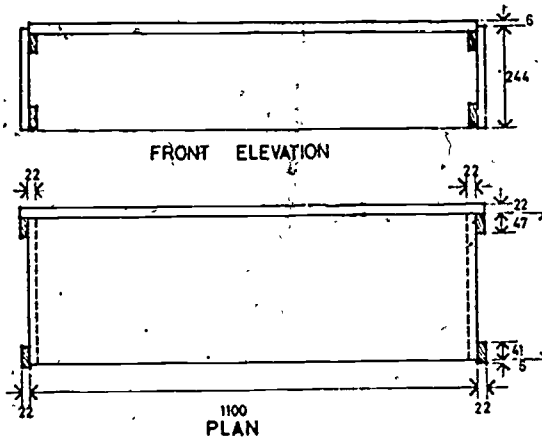
The Ministry of Education in Sri Lanka became involved in the project rather late in the day - after the design stage, and after the production of the first prototypes. Up to this time ARISBR had had few contacts with the Ministry of Education. The designer was unable to make modifications to his designs after testing under classroom conditions, because he was in Sri Lanka for only six weeks. However, modifications were made by other ARISBR staff members. There was no means of controlling the quality of the large-scale production of furniture, nor was there any quality control when the furniture arrived at the schools. Since the project dealt only with tables and chairs, it was not considered necessary to issue a users' guide. ARISBR has issued user guides with its science furniture and, since AGOPA took over in Colombo, seminars have been held to explain the use of the new science furniture.

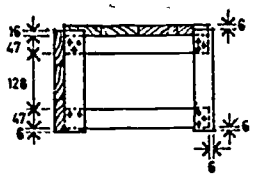
The project was always considered as a regional undertaking, although the furniture was developed specifically for Sri Lanka. In practice, the project came to the notice of the administrators responsible for the supply of school furniture in many countries of the region because of the publication of details of the furniture as ARISBR School Building Digests 6 and 7, seminars organized at ARISBR headquarters in Colombo, and the travel of ARISBR staff members.

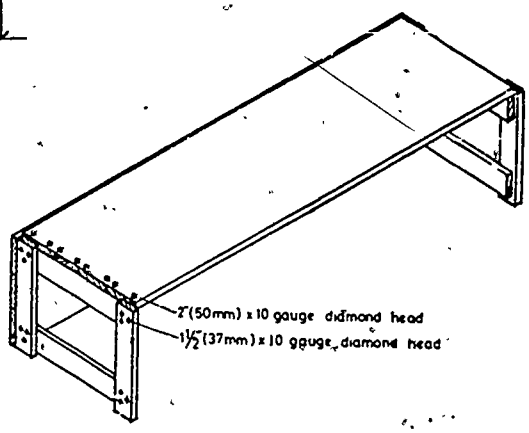
Afghanistan, Bangladesh, India and Indonesia have all produced furniture based on these ARISBR designs. Indonesia has produced 750,000 units. In each case the original ARISBR designs have been modified in a manner appropriate to the individual countries involved.

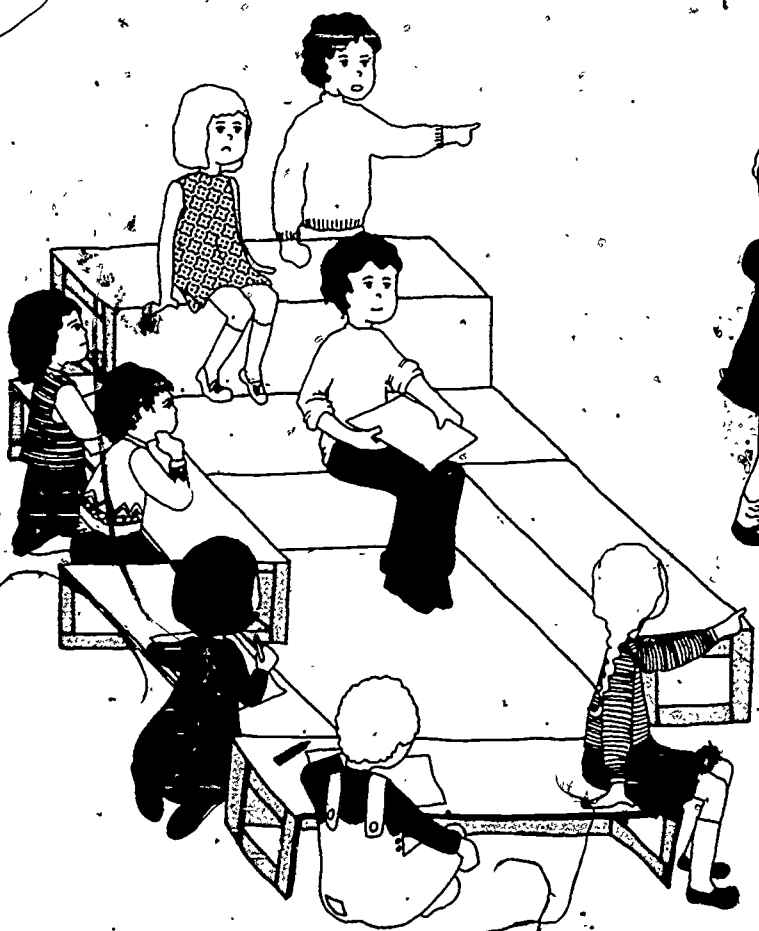
Overcrowded classrooms and a high furniture breakage rate, even for ARISBR desks and chairs, mean that there is a continual shortage of classroom furniture in Sri Lanka.

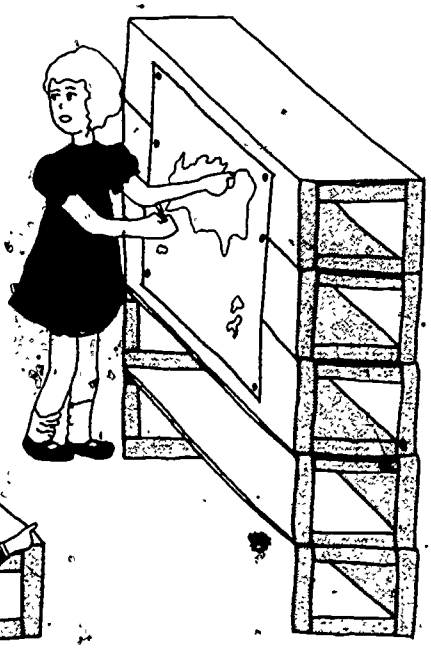
Bearing in mind the special problems of the country, it is thought that a solution along the lines of the Multi-purpose Furniture Unit develop-











MULTI-PURPOSE UNIT

ed for Nepalese schools (see School Building Digest No. 10 "A Simple Multi-purpose Furniture Unit") would be more appropriate for primary schools than the present tables and chairs. While it is recognized that the multi-purpose unit does not have the same prestige as tables and chairs, it does seem preferable to them for the following reasons:

Straightforward construction using the techniques of the packing case industry.

Lack of a backrest, permitting easy construction (backrests are not considered indispensable since primary school classes are held for only four hours a day);

Used as a bench with tables, it can be turned to give two seat heights, thus eliminating the need for two separate items of furniture. This is also an advantage when benches have to fit in with existing tables higher than the standard table.

Three children can sit at one bench when classrooms are crowded.

Two units can be used as a table if there is a shortage of tables.

Benches can be used as squatting tables where there is severe furniture shortage.

It can be used easily for informal arrangement of the classroom. It is not a bulky item and can be easily stacked. The degree of multi-purpose use to which furniture can be put in practice is illustrated, for instance, by the photograph on page 19 showing a desk used as a stool.

As a response to the need for tables and chairs, the ARISBR designs solved a certain number of problems, but not all. In general, the remaining problems may be solved in two ways:

by accepting the shortcomings of the Sri Lanka furniture factories and designing furniture which takes these shortcomings into account. For example, glue could be dispensed with and nails used instead of screws.

or by seeing to it that designs are drawn up in close collaboration with the factories so that manufacturers undertake to correct production faults. For instance, the Sri Lanka screw factory might be prevailed upon to produce rust-proofed screws and nails and to provide electric drills to make pilot holes in order to remove the temptation of hammering home screws. Seasoned timber might be used.

Much importance was given by ARISBR to the 'good fit' of school furniture - have the right size of table or chair in relation to the height of the student. The result was an ARISBR range of five sizes, covering the age range of six years to adult. This was a greater number of sizes than the Sri Lanka authorities were able to deal with administratively. It is thought that for practical purposes, emphasis should be given to 'margins of tolerance' - tolerable or permissible 'misfit' in furniture.

Margins of tolerance vary with the type of furniture and vary each side of the fit position. For chairs, the margin of tolerance under fit is greater than that above fit; that is, one is more comfortable sitting on a chair that is low, rather than on a chair that is high. The acceptable margin of tolerance then gives the incremental difference between furniture sizes; this would result in a range of less than five sizes. If a chair is to be used for a wide age-range, it might be useful to introduce a footrest for the use of younger children.

It is recommended that a study be made of distribution of stature sizes and that fitting trials be carried out in actual classrooms to establish a satisfactory selection of a reduced range of furniture sizes.

A reduced range of sizes would be easier administratively:

for manufacturing, ordering and supply purposes;

for organization within the school. It is not always easy to limit an age-group to the rooms filled with age-group's furniture. Many primary schools are organized with two shifts. Secondary schools have subject bases, not class bases - children move from subject-room to subject-room.

It must be remembered that in a school situation:

Classes are not selected in accordance with the height of the children, but on the basis of levels of ability - there are often considerable differences of height between children in a class.

With a rising standard of living, and with better nutrition, the average height of students in Sri Lanka may well rise. In this context the example of Japan is worth quoting: between 1900 and 1971 the average height of 13 year-old boys rose by 14.4 cm, and that of 12 year-old girls by 15.5 cm.

New furniture often has to be made to fit in with old furniture. Chairs wear out quicker than tables; an old table with new chairs is a frequent occurrence. This should be borne in mind when establishing margins of tolerance.

Case Study of a Project to Equip Three Secondary Schools in Tunisia

This project was part of a Swedish financed Unesco "Funds in Trust" project for the construction of three girls' secondary schools in Tunisia (the schools have since become mixed - boys' and girls' schools). The schools are at Béja, Nabeul and Sfax. Furniture was not originally part of the project, but half-way through its implementation it was decided that the schools, whose designs implied innovative education, should be equipped with furniture that would help make innovation a reality.

There has been no change in Tunisian school furniture since independence in 1956. Existing furniture is identical to pre-1956 French models. All classrooms, primary as well as secondary, are equipped with desks for two with a bench for two attached. In order to produce designs for the production of modern furniture in Tunisia, the Tunisian government made a request for technical assistance to Unesco.

In March 1969, Unesco appointed an architect and furniture designer to work for the Tunisian Ministry of Education in the Buildings Division, under the guidance of the Director of the Division.

DESIGNING AND MANUFACTURING OF THE FURNITURE

The designer's terms of reference (see Appendix I) were to design and supervise the manufacture of furniture for the three schools at Béja, Nabeul and Sfax. It was understood, although this was not stated in the designer's contract, that this furniture would be designed in such a way that it could eventually be adopted nationwide in all the secondary schools in Tunisia.

It was also specified in the terms of reference that the designer should concern himself with all the furniture required in a secondary school, but in three months it was clearly impossible to do justice to every aspect of the question.

The following is a list of equipment omitted from the study: laboratory benches, amphitheatre furniture, gymnasium equipment; chalkboards, noticeboards; storage units for maps and charts; dormitory storage; and kitchen equipment.

Contacts with the eventual users of the furniture were not encouraged by the Tunisian authorities. However, the designer criticized existing furniture and suggested improvements, and these improvements are incorporated in the design of the new furniture.

The definition of user requirements is usually a lengthy process; it entails the analysis of the teaching methods employed, both in theory, and in the reality of the classroom; it requires lengthy interviews and meetings with all those concerned with schools, it requires visits and the observation of schools in action. Furniture can then be designed which helps promote these methods and ideas, and at the same time takes into account possible changes in education itself.

The designer made a preliminary visit to Tunisia, of two weeks, at the end of April 1969, a visit of one week in mid-June, and a visit of one week in mid-July. Between these dates design work was carried on in the designer's office in Athens.

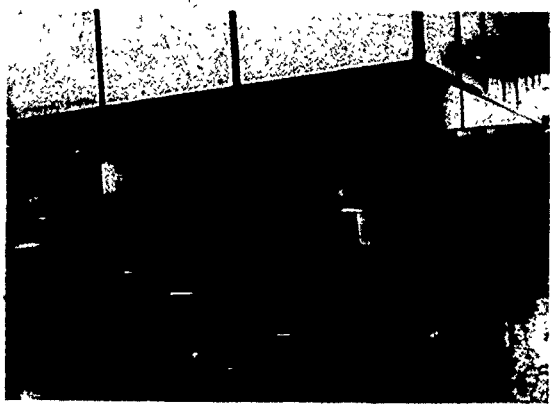
Design drawings were made which were used to produce a limited range of prototypes - one or two of each item - at the factory of a supplier in Jendouba. The designer made a further visit of one week to Tunisia, in February 1971, for the evaluation of the prototype furniture. The furniture was then put out to tender in accordance with Tunisian Government tender regulations. Tenders were let on 8 April 1971.

The findings of the designer in respect of existing school furniture can be summarized as follows:

the dimensions of the furniture are incorrect since they do not permit children to adopt a proper posture;

Béja Secondary School: spaces for which equipment was not provided within the scope of the project

Laboratories



Kitchens

Notice boards in corridors

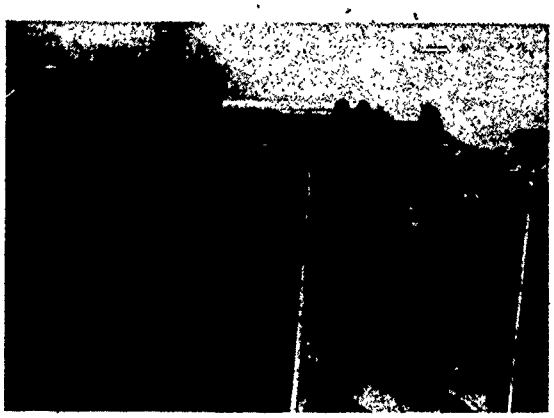


Chart store

Gymnasium

Amphitheatre

the tables are heavy. It is difficult to change the position of furniture, to move it about, to allow different grouping of tables;
the fixing of the wooden tops to the metal legs of the tables is not strong enough. The table tops often come loose;
the table surfaces are not hard enough,
modern materials such as plastics and chipboards have not been used.

These criticisms refer to the desks for two with benches attached.

The research into materials only applies to the availability of wood products and steel tubing. It does not deal with the many less basic products used in furniture production such as plastic inserts, hardware of all sorts, paint, screws, fixings, etc.

Two factories were visited - Gozlan and Le Maghreb. Notes were made on the type of machine tools and equipment available and on the quality of the workmanship. Unfortunately, only a small amount of the final furniture order went to these two factories. The factories that won the major part of the order were hopelessly under-equipped, possessed an inadequate number of technicians and were unable to produce the furniture as designed. As stated in the designer's final report, the statistical base for the anthropometric study was not large enough and gave only an "incomplete appreciation" of the situation. This is less important than it seems, however, because three different sizes of tables and chairs were produced and it should prove possible to determine the size of furniture appropriate to each age-group by holding fitting trials in the schools.

THE CHAIR

The chair, as manufactured, will not stack, although it was designed to stack. The design requires that the tube be held at an angle to the bed of the pipe-bender so as to obtain the configuration needed for the chair to stack. This is difficult - not impossible - to achieve using the simple pipe-bending machinery found in Tunisia. Certainly, the manufacturer who won the contract had not understood the design. But without changing the basic conception of the chair, the design could be simplified so that all bending is done parallel to the bed of the machine.

In England chairs of this model feature direct butt welds rather than tangential welding of the kind favoured in the Tunisian project.

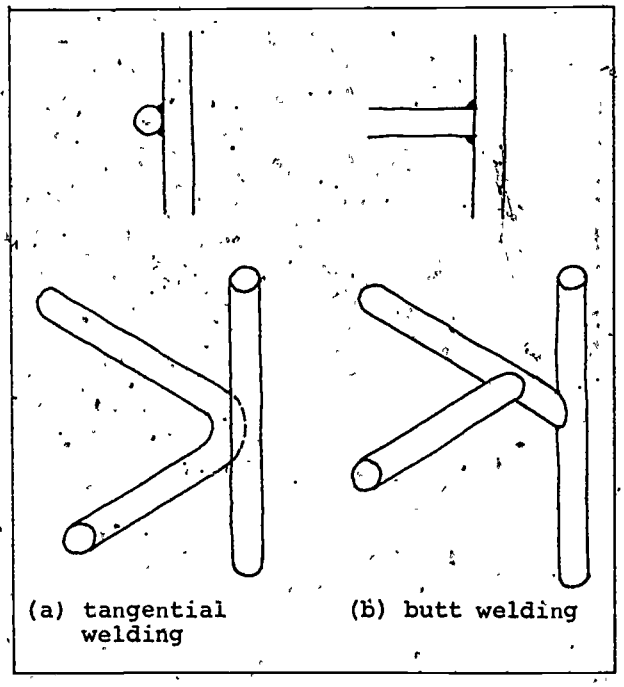
Butt welding requires an extra weld. Also, the ends of the tube must be ground to fit the tube to which it is welded. Although more operations are required, the result is stronger. This is particularly desirable in Tunisia since, in general, joints are brazed rather than welded. Brazing uses lower temperatures and distorts the tubes less during manufacture but, to be effective, the surfaces to be joined must be clean. Already, several brazed joints in the experimental chairs have failed.

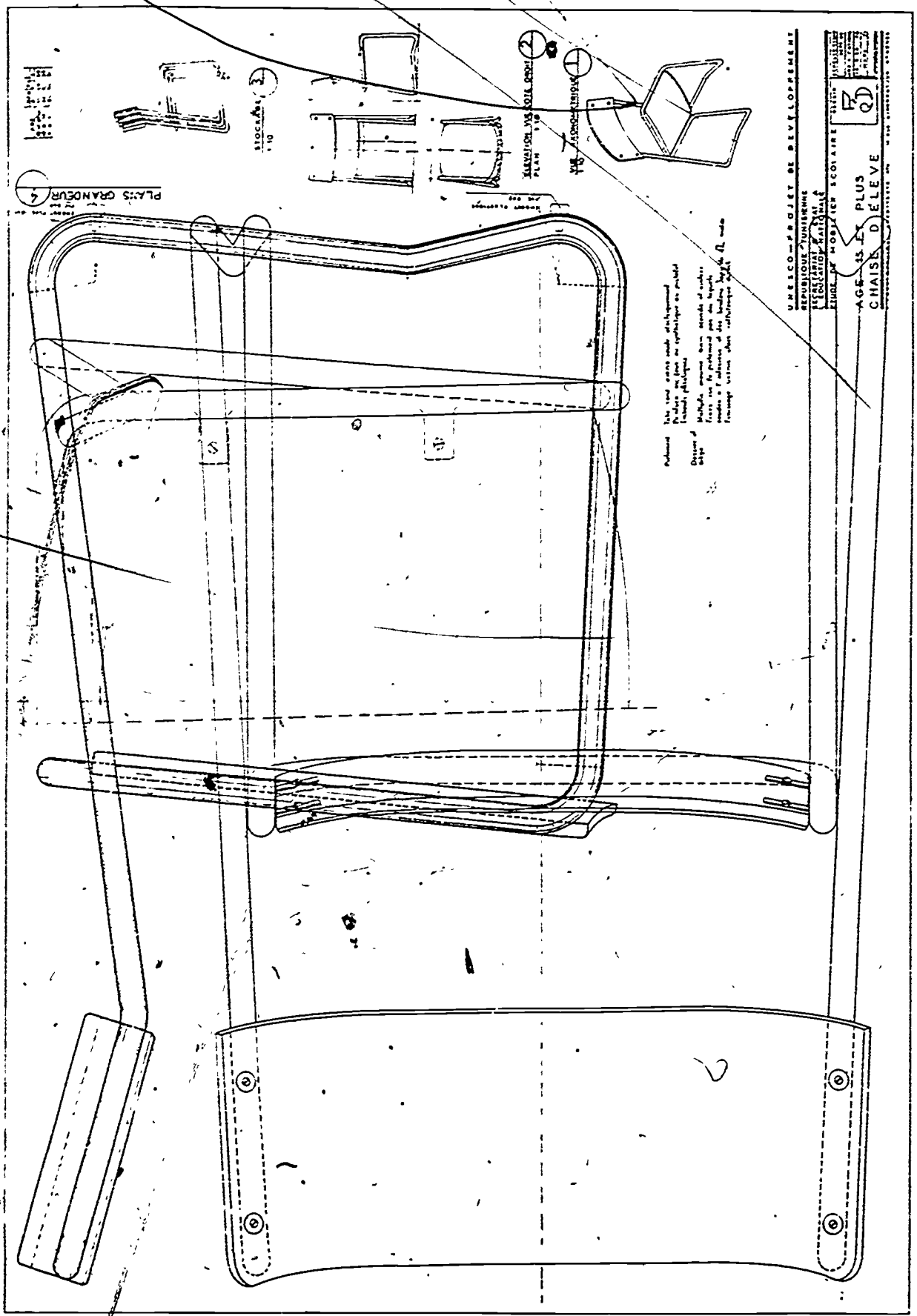
As the design shows, the chair is supposed to be made of a single length of tube. But the manufacturer found it impossible to realize this concept using the pipe-benders that he possessed. He therefore introduced an additional joint in the middle of the back rail of the chair. A sleeve of a smaller diameter is provided for and the two tubes to be jointed are then butted together and welded. This makes a strong joint, but it is a further operation not foreseen in the original design.

Generally, the chair seems weak. The plywood seat is supported on two sides only. If too much weight is put on the seat - if someone stands on it - it will break.

The front edge of the seat is not curved. Yet curved front edges are recommended in most standard specifications for chairs. A seat without a curve on the leading edge tends to be uncomfortable for someone sitting with legs tucked under the chair. The seat is made of two sheets of 3 mm plywood glued together in a hand press. Since, under present conditions, it is not possible to produce seats curved in two directions, it would have been better to have the seat curve from back to front instead of sideways, so as to have the curve on the front of the chair.

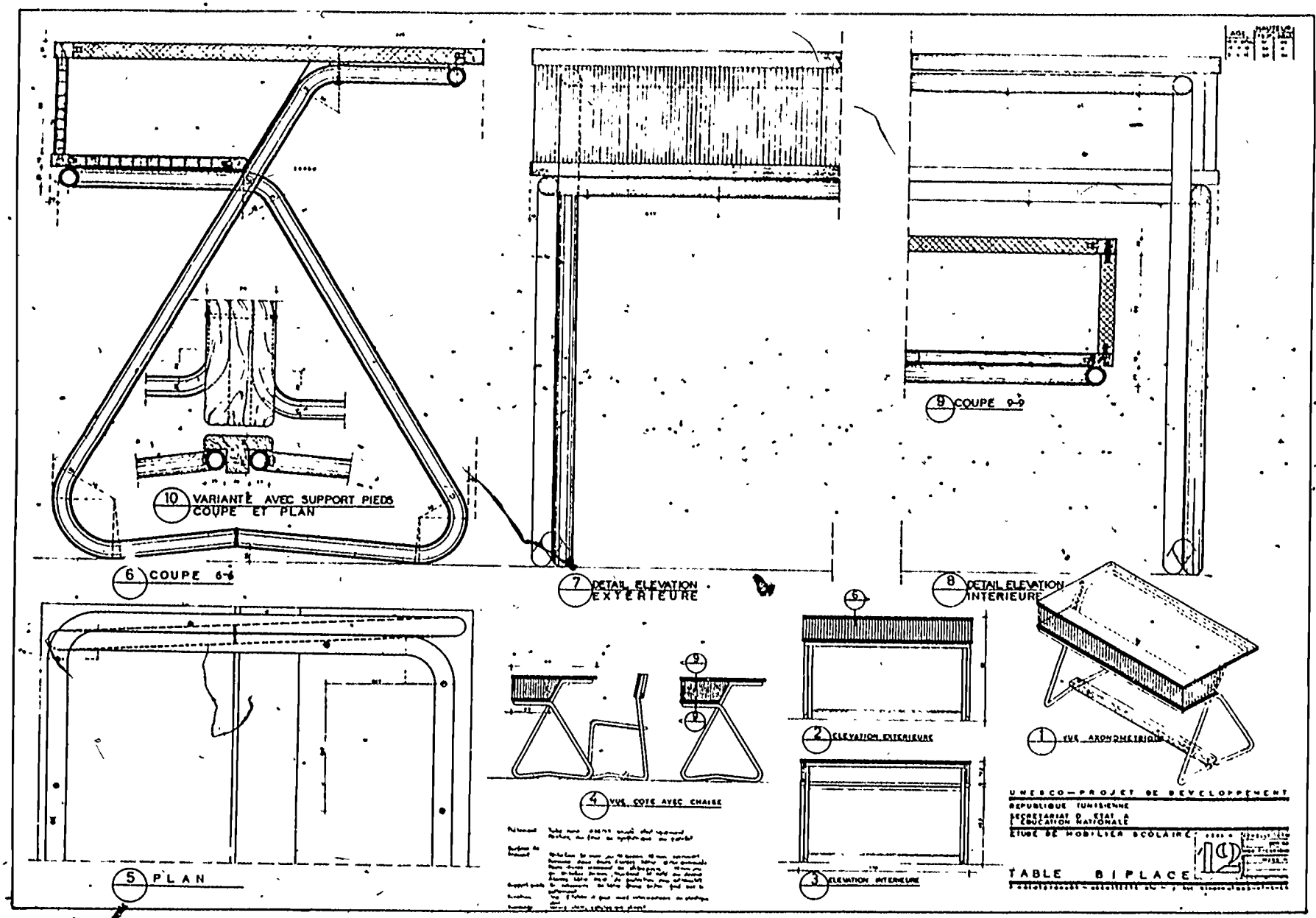
None of the experimental chairs are fitted with the plastic inserts shown in the drawings. The manufacturer claims that these are unobtainable in Tunisia and that the small scale of the order would not justify having them purposely made.




UNESCO—PROJET DE DÉVELOPPEMENT
RÉPUBLIQUE TUNISIENNE
MINISTÈRE DE L'ÉDUCATION NATIONALE
MODÈLE DE MOBILIER SCOLAIRE
AGE 13 ET PLUS
CHAISE D'ÉLÈVE
PLAN
PLAIS GRANDEUR

Students' desk and chairs

Broken chairs


10 VARIANTE AVEC SUPPORT PIEDS
COUPE ET PLAN
6 COUPE 6-6
7 DETAIL ELEVATION EXTERIEURE
8 DETAIL ELEVATION INTERIEURE
9 COUPE 9-9
5 PLAN
4 VUE COTE AVEC CHAISE
2 ELEVATION EXTERIEURE
3 ELEVATION INTERIEURE
1 VUE AXONOMETRIQUE
UNESCO — PROJET DE DEVELOPPEMENT
REPUBLIQUE TUNISIENNE
SECRETARIAT D'ETAT A L'EDUCATION NATIONALE
ETUDE DE MOBILIER SCOLAIRE
TABLE BIPLACE
112

Even if inserts were fitted, it is doubtful whether they would stay in place given that they are only secured by friction against the wall of the tube which would not be more than 1.5 mm thick. Generally speaking, inserts sleeved into the open ends of the tubes are much more effective since they are kept in place by friction on a much greater area of tube.

The plywood seat and backrest are fixed to the tubular frame by nuts and bolts, through to lugs welded to the tube, in the case of the seat, and threaded directly through the tube, in the case of the backrest. The end of the bolt is then hammered down over the nut to prevent its removal. This is an excellent method of fixing, but it is expensive. Alternative methods of fixing should be found.

THE DESK

The desk is not designed to stack. Although it can be argued that this is not indispensable in a classroom situation, it could help reduce the cost of transport to the school.

The desks are shown in the drawings with the table tops made of chipboard and the shelf assembly made of blockboard. The tables, as manufactured, are made entirely of chipboard. This, and the large amount of steel used makes for a heavy table that is difficult to move from place to place in order to permit the kind of classroom arrangements required in modern teaching.

Although it is not so indicated on the drawings, the desks are provided with plastic pads screwed to the tube. These pads are ill-conceived since the screw is in contact with the floor, not the pad, and much noise results.

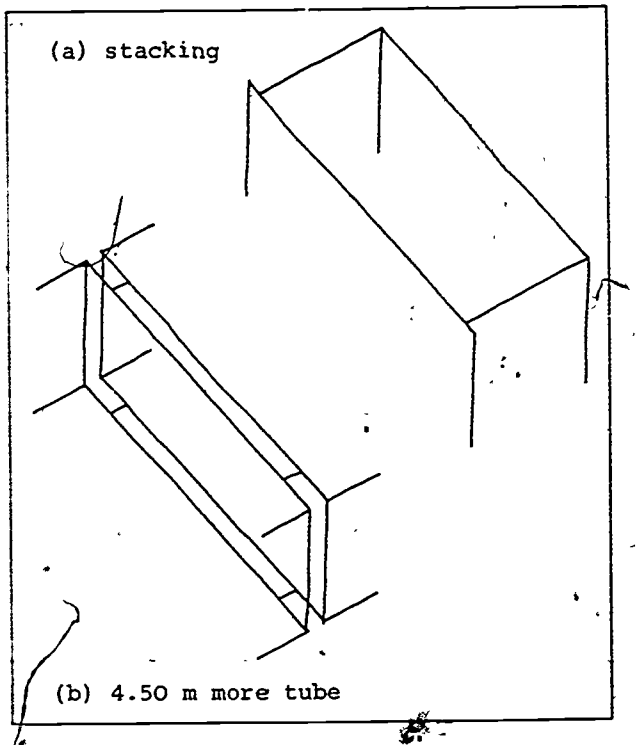
Also, the footrest seems a rather complicated solution to the cold floor problem. It is made of two 25 mm diameter tubes covered by a plank of kiln-dried beech. This adds unnecessary weight to the desk.

The desk, along with its two chairs, is designed to replace the table-bench combination costing about 11, 500 D, now in use in secondary schools. The two chairs of the experimental project cost 3, 000 D each, the table 12, 600 D, a total of 18, 600 D (it should be remembered, however, that these prices are probably about 10 per cent higher than the price of full production models). It seems desirable to reduce the price of the desk closer to the level of the 'Table Simple' of the experimental project (see drawing 13, page 36), priced at 9, 500 D. This would give an over-all cost of 15, 500 D for both the desk and its two chairs.

Lastly, the joint, at the pivot of the scissors on the desk's legs, and shown as bolted on the drawings, has in fact been welded.

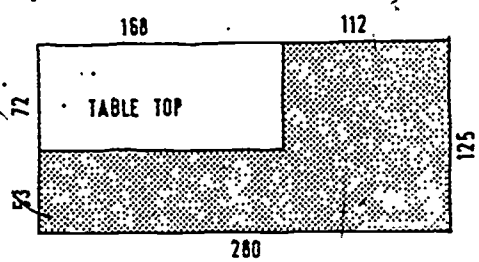
REFECTORY TABLE

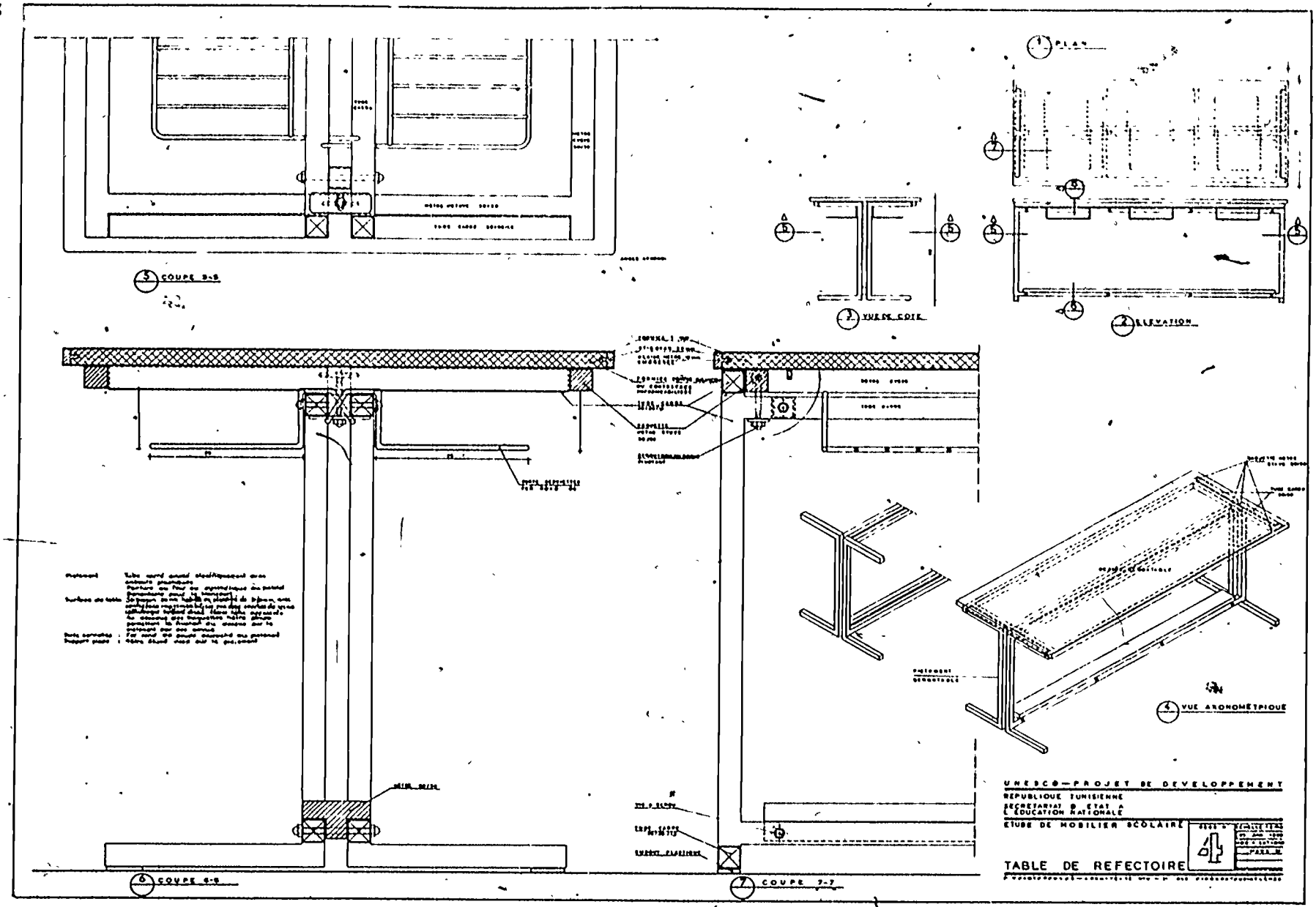
This table has been designed so as to eliminate legs at the table corners because these may be considered awkward or unaesthetic. It uses 4.50 m more tube than a table with legs at the corners and even then the long sides of the chipboard top require bracing by two members of 30 x 30 mm kiln-dried beech.



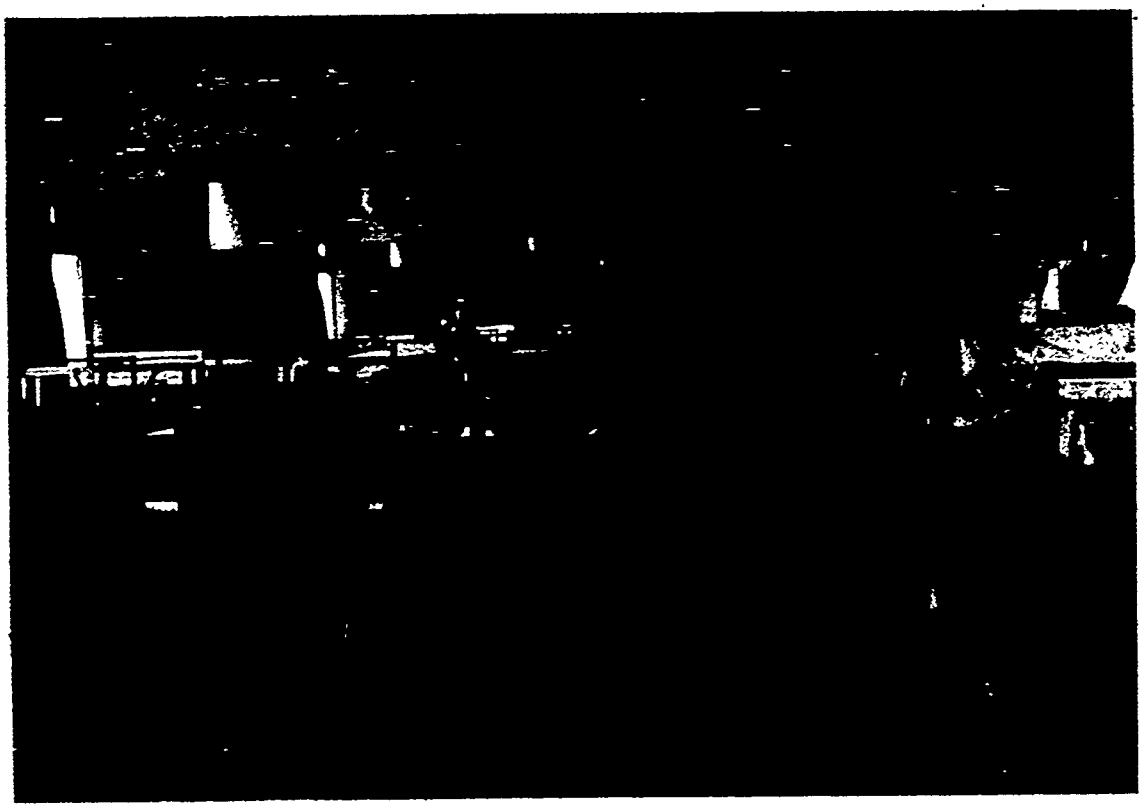
The table is designed to knock down for stacking to facilitate its transport and normal use. But the system is too complicated for everyday needs requring the use of a spanner. Moreover, having the top made as a separate part adds considerably to the over-all weight. In addition, the support members to the table-top need to be doubled. It is worth observing that a table with legs at the corners could also be made to stack.

The laiminated plastic table tops have been made in three sections. Laminated sheet imported into Tunisia measures 280 x 125 cm. It was only possible to cut one table top per sheet. The manufacturer therefore took the decision to make the top in three sections.

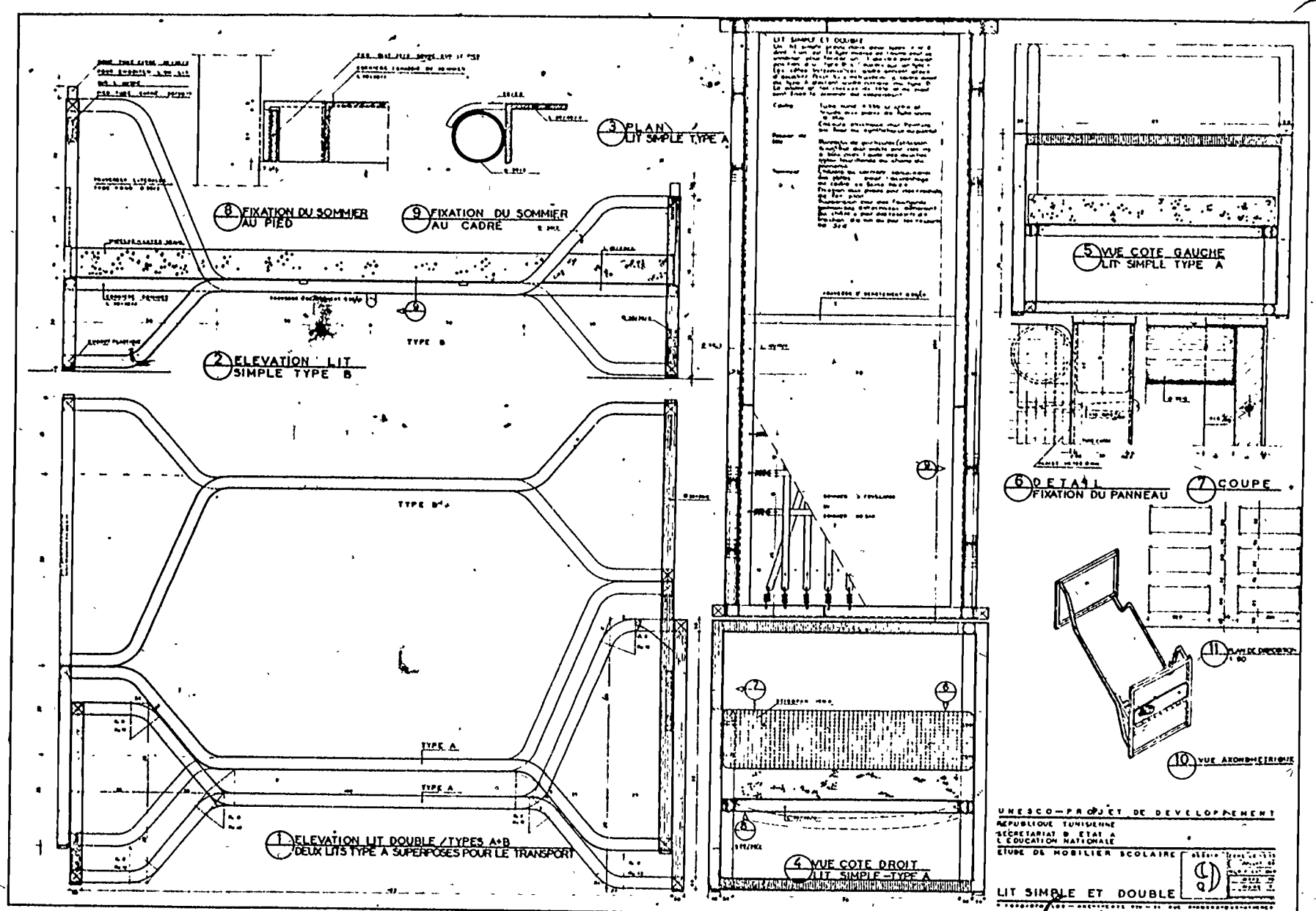


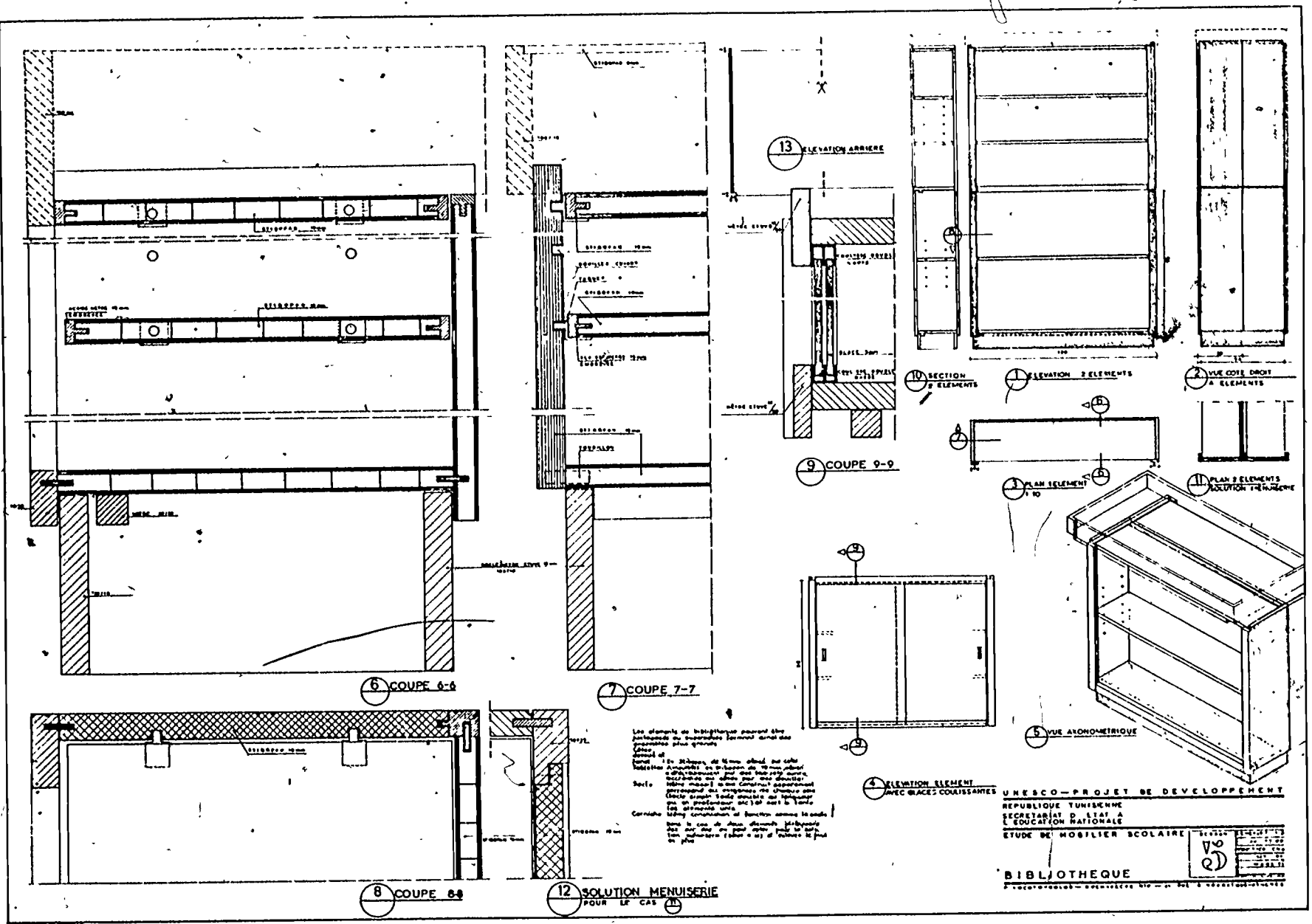

1 PLAN
2 ELEVATION
3 VUE DE COTE
4 VUE AXONOMETRIQUE
5 COUPE B-B
6 COUPE 6-6
7 COUPE 7-7
UNESCO—PROJET DE DEVELOPPEMENT
REPUBLIQUE TUNISIENNE
SECRETARIAT D ETAT A L EDUCATION NATIONALE
ETUDE DE MOBILIER SCOLAIRE
TABLE DE REFECTOIRE

Refectory tables



Double bunks


3 PLAN LIT SIMPLE TYPE A
8 FIXATION DU SOMMIER AU PIED
9 FIXATION DU SOMMIER AU CADRE
2 ELEVATION LIT SIMPLE TYPE B
TYPE B
TYPE A
TYPE A
1 ELEVATION LIT DOUBLE / TYPES A+B DEUX LITS TYPE A SUPERPOSES POUR LE TRANSPORT
4 VUE COTE DROIT LIT SIMPLE - TYPE A
5 VUE COTE GAUCHE LIT SIMPLE TYPE A
6 DETAIL FIXATION DU PANNEAU
7 COUPE
10 VUE AXONOMETRIQUE
UNESCO - PROJET DE DEVELOPPEMENT
REPUBLIQUE TUNISIENNE
SECRETARIAT D ETAT A L EDUCATION NATIONALE
ETUDE DE MOBILIER SCOLAIRE
LIT SIMPLE ET DOUBLE

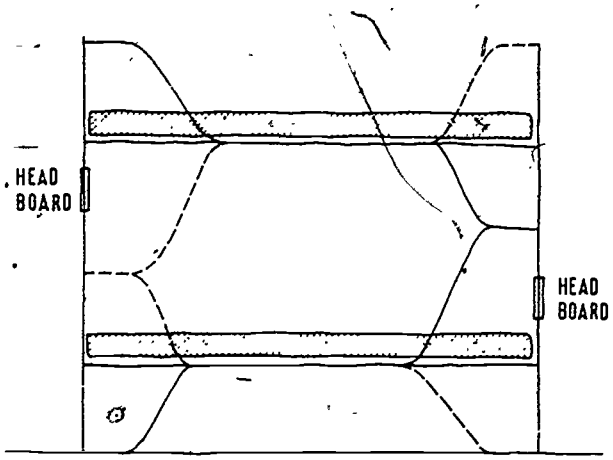

13 ELEVATION ARRIERE
9 COUPE 9-9
10 SECTION 2 ELEMENTS
1 ELEVATION 2 ELEMENTS
2 VUE COTE DROIT 4 ELEMENTS
3 PLAN ELEMENT
11 PLAN 2 ELEMENTS SOLUTION MENUISERIE
6 COUPE 6-6
7 COUPE 7-7
5 VUE AXONOMETRIQUE
4 ELEVATION ELEMENT AVEC GLACES COULISSANTES
8 COUPE 8-8
12 SOLUTION MENUISERIE POUR LE CAS
UNESCO — PROJET DE DEVELOPPEMENT
REPUBLIQUE TUNISIENNE
SECRETARIAT D'ETAT A L'EDUCATION NATIONALE
ETUDE DE MOBILIER SCOLAIRE
BIBLIOTHEQUE

34

33

THE BED

Even when used in the double bunk position, the bed is extremely solid and stable. The beds can either be used singly, or two can be stacked to form a double bunk, but since the head-board is higher than the foot-board, the top bed must be inverted in order that the two beds fit together.



This method has two disadvantages:

the spring frame of the top bed must be turned, that is, it must be left face uppermost when the bed is inverted. It must therefore be separate from the rest of the bed - an added complication, which also tends to make the bed heavier.

the top bed's head-board is below the feet of its occupant who has no board at his head (see sketch).

Although the bed is solid and stable, its price, compared with existing double beds, is high - 25,380 D compared to 16,500 D. Also, the beds inspected had not been fitted with the plastic inserts shown on the drawings. The mattresses are of polyurethane foam.

LIBRARY SHELVES

For a country like Tunisia with few timber resources, the library shelves use too much wood.

Again, the shelves have been made of chipboard instead of blockboard, as was called for on the drawing. They have a pronounced sag under the weight of the books.

ADJUSTABLE STOOLS

The stools are expensive: 6,600 D compared with a price of 2,000 D for the existing fixed-height school stool. This is due to the large amount of imported, kiln-dried beech used (the seat is 50 mm thick) and to the expensive swivel mechanism which, because of import restrictions, is hand-made in Tunisia. There is no clear reason why the seat of the stool should be so thick.

The swivel mechanism is of poor quality and there is too much play in the thread of the screw with the result that the seat wobbles when it is extended. The amount of wobble increases with the extension of the seat.

The stool is designed to be used with the drawing table, which is itself made in such a way that the drawing board can be placed at one level for industrial drawing and at another level for art drawings requiring a stool of adjustable height. But there seems to be no real justification for two levels.

No provision has been made for caps or inserts to the stool legs. The steel rods are directly in contact with the concrete floors and this produces noise.

SIMPLE TABLE

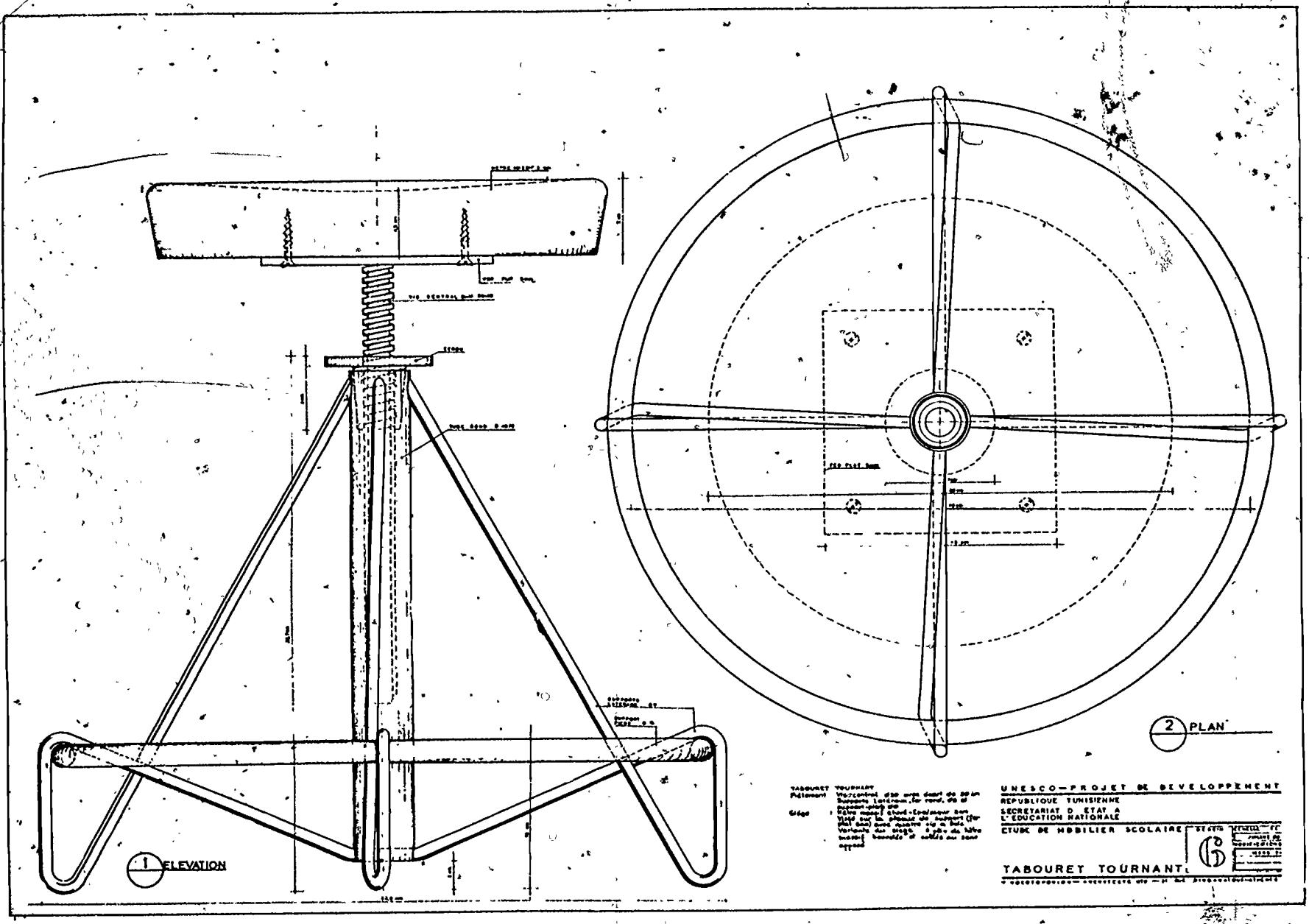
This table could be made to stack by a slight adjustment to its carcase, thus increasing its usefulness and allowing it to be transported more easily.

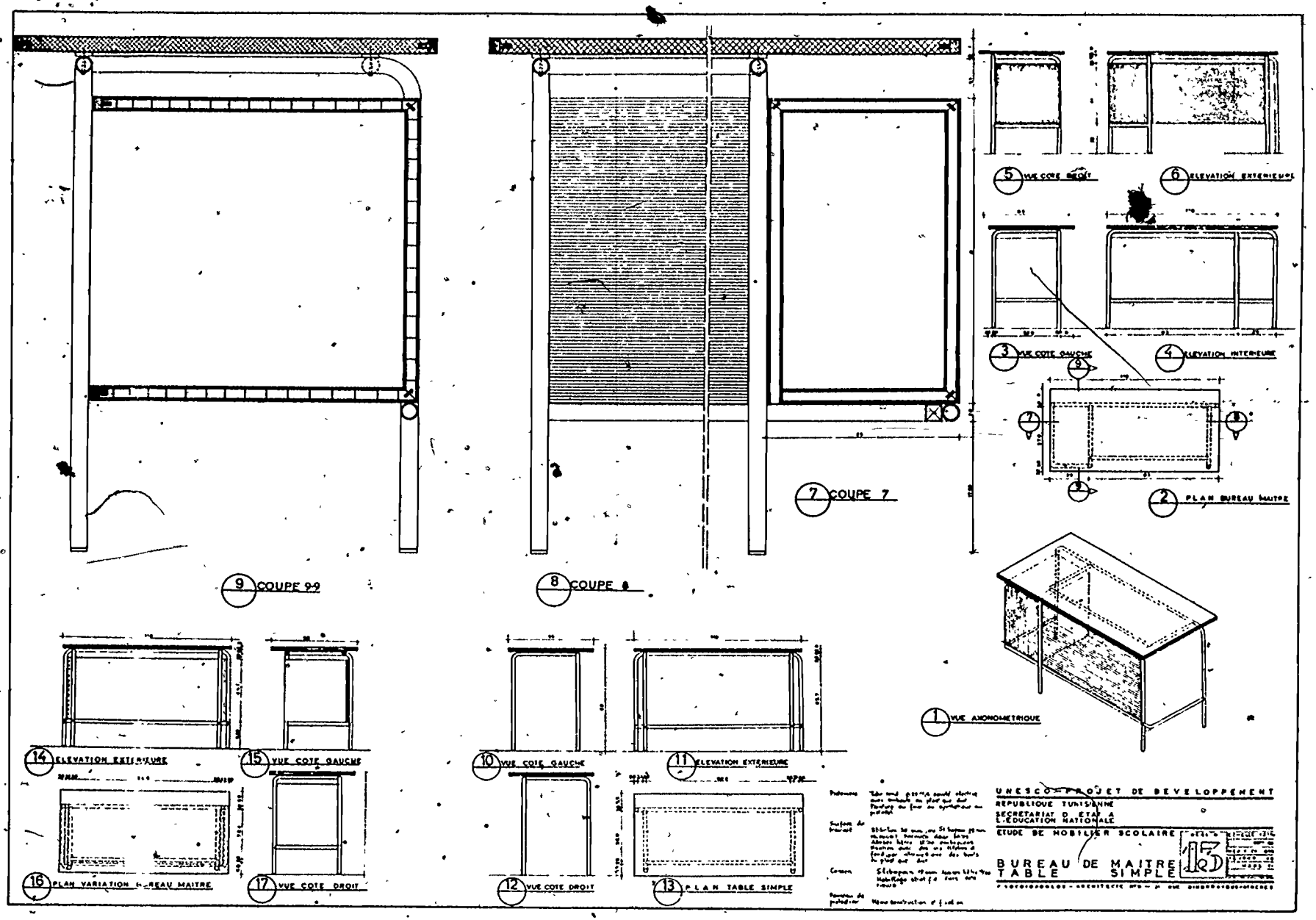
The frame which supports the chipboard table-top runs round three sides of the table only. The chipboard on the fourth side is unsupported and has bowed. When using chipboard it is important to provide all-round support, particularly when the table top alone is faced with plastic laminate, without a counter balancing sheet on the underside (see page 38).

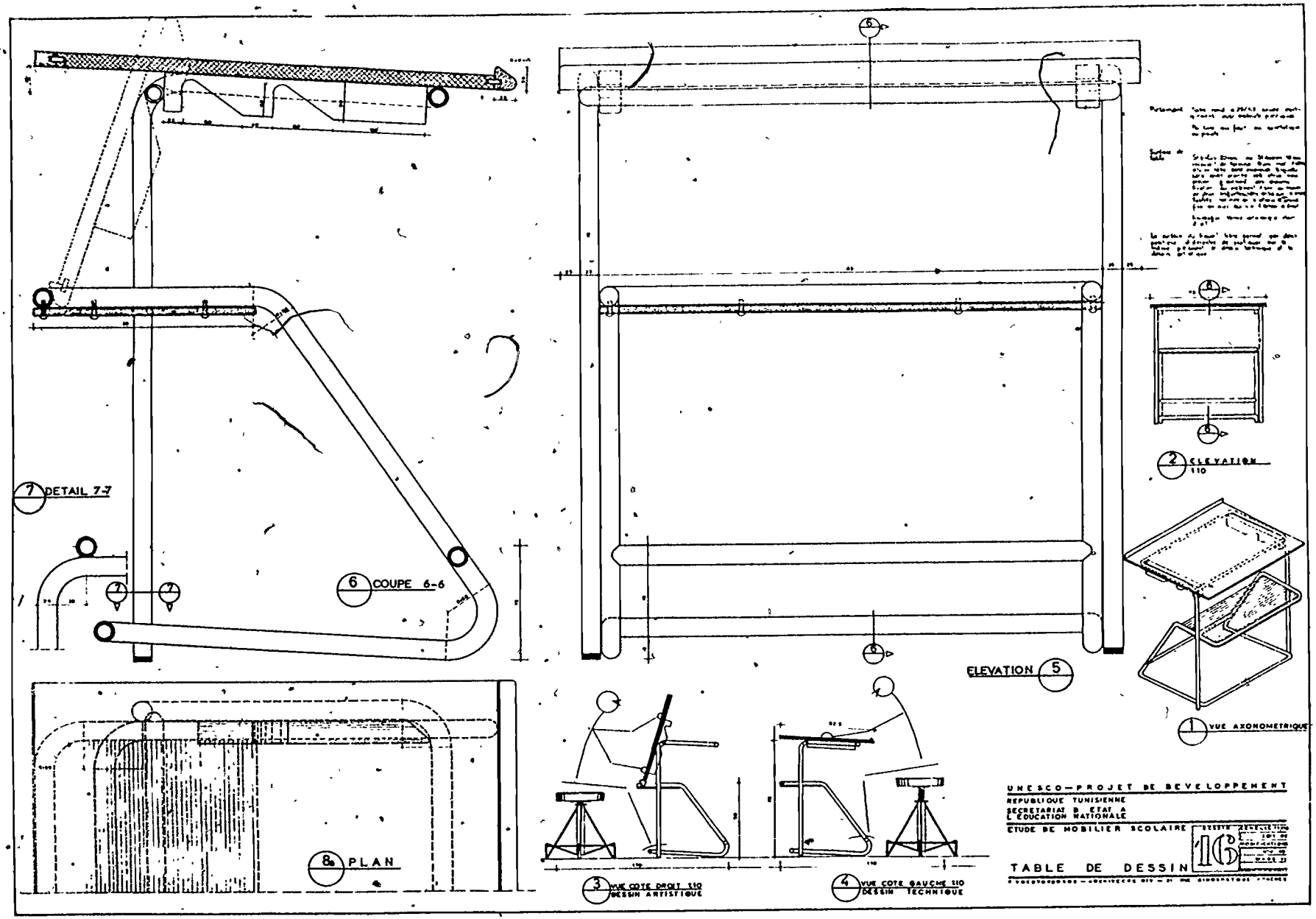
DRAWING TABLE

The existing school drawing-table is adequate and the experimental table constitutes no improvement on it.

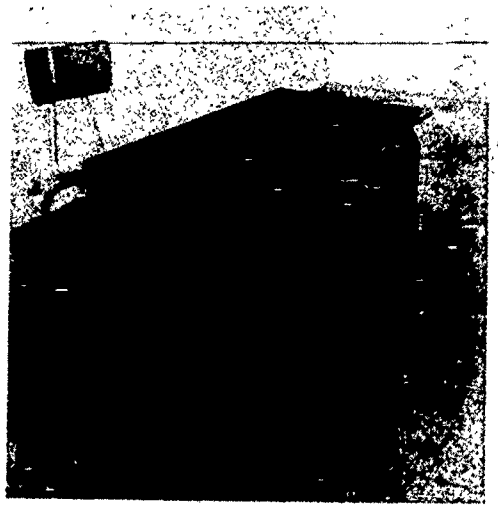
The experimental table has two set positions, one for technical drawing and one for art drawing whereas the existing table has variable positions to suit individual taste. With the experimental model the student must change from one side of the table to the other or turn the table in order to change from technical to art drawing (see the sketch at the bottom of drawing 16, page 37). Furthermore, the height of the stool must be changed: this is the reason for the adjustable-height stool - an expensive complication. A point in favour of the existing table is that it avoids tangential welding situations. Again, all four feet of the existing table take plastic insert buffers. Two of the feet of the experimental table are left without them.


1 ELEVATION
2 PLAN
UNESCO—PROJET DE DEVELOPPEMENT
REPUBLIQUE TUNISIENNE
SECRETARIAT D ETAT A L'EDUCATION NATIONALE
CTUDE DE MOBILIER SCOLAIRE
TABOURET TOURNANT


9 COUPE 9-9
8 COUPE 8
7 COUPE 7
5 VUE COTE DROIT
6 ELEVATION EXTERIEURE
3 VUE COTE GAUCHE
4 ELEVATION INTERIEURE
2 PLAN BUREAU MAITRE
1 VUE AXONOMETRIQUE
14 ELEVATION EXTERIEURE
15 VUE COTE GAUCHE
16 PLAN VARIATION BUREAU MAITRE
17 VUE COTE DROIT
10 VUE COTE GAUCHE
11 ELEVATION EXTERIEURE
12 VUE COTE DROIT
13 PLAN TABLE SIMPLE
UNESCO - PROJET DE DEVELOPPEMENT
REPUBLIQUE TUNISIENNE
SECRETARIAT D'ETAT A L'EDUCATION NATIONALE
ETUDE DE MOBILIER SCOLAIRE
BUREAU DE MAITRE
TABLE SIMPLE
15 bis


7 DETAIL 7-7
6 COUPE 6-6
8 PLAN
ELEVATION 5
2 ELEVATION
1 VUE AXONOMETRIQUE
3 VUE COTE DROIT 1/10
DESSIN ARTISTIQUE
4 VUE COTE GAUCHE 1/10
DESSIN TECHNIQUE
UNESCO — PROJET DE DEVELOPPEMENT
REPUBLIQUE TUNISIENNE
SECRETARIAT D'ETAT A L'EDUCATION NATIONALE
ETUDE DE MOBILIER SCOLAIRE
TABLE DE DESSIN
16

Adjustable stools



Teachers' table

TEACHER'S TABLE

No comments.

HEADTEACHER'S TABLE

This is a beautiful piece of furniture but it uses a great deal of wood and is expensive - 54,300 D.

Having the drawers on castors, as a separate unit is a good idea. Unfortunately, the drawers do not have the manoeuvrability that one would expect; they are restrained, to a large extent by the footrest and the traverse members and would be more manoeuvrable under a table without low level cross braces.

TYPIST'S TABLE

The table is designed to have only two welds; in fact, the model inspected had four.

The table has been made without plastic inserts for the feet and this will result in noise.

OVERVIEW

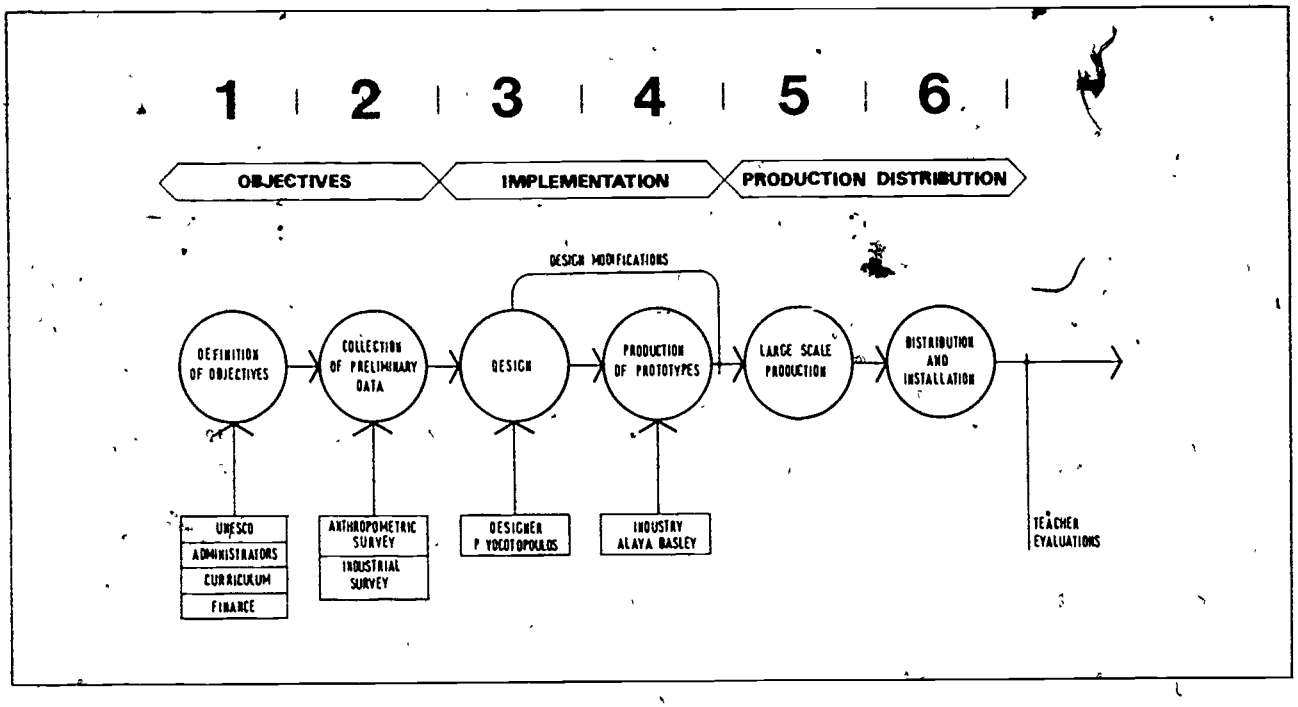
The consultant visited Tunisia in February 1971 to examine the prototypes made by the supplier at Jendouba. This supplier won only a small part of the final contract, yet the items produced by other manufacturers were not up to the high standards evident in the case of his prototypes.

The furniture itself was not tested under classroom conditions before production began, nor was classroom use simulated under factory conditions. Certain defects have since been revealed by classroom use which did not come to light by simply examining the first prototypes. The testing stage was omitted in order to have the three schools equipped and ready for the start of classes in September 1972.

In general, the furniture was badly made. Welding was poorly executed, especially butt welds. Painting was inadequate; quite a number of items already show signs of rust. The bending does not conform to the drawing and because of this, the chairs will not stack. Major manufacturing defects are outlined in observations on the design of furniture. (See Appendix). All the furniture, except that produced by the supplier at Jendouba, was of inconsistent quality. There was no quality control during manufacture, nor on arrival at the schools.

Little time was available to 'communicate' to the users of the furniture the reasons for the changes in design and their relation to education. No user meetings were held. After the furniture had been in use for a year, a furniture evaluation form (see Appendix II) was sent to the teachers at the three schools in question. These were filled in by teachers and sent back to the Ministry. This was the first chance the teachers had had to express their views on the furniture. The completed evaluation forms were predictably negative.

The project was not successful in producing technically sound furniture, in introducing the idea that improved furniture could lead to better educational results, or in convincing administrators and



teachers of the need for change in this field, at a national level. Its development is summarized in the diagram above. The process followed the pattern outlined in the introduction to the evaluations but with certain differences.

The objectives of the project were defined without consultation with school directors, teachers or school children. The Tunisian authorities were never entirely convinced that innovation was necessary in the field of school furniture. Perhaps because of this, no systematic study of user requirements was authorized. User requirements were not stated in any of the project documents. In consequence, the design of the furniture suffered, since its function was never clearly defined.

Because of the need to have the three schools equipped for the start of classes in September 1972, the prototypes were not put to the test under classroom conditions. It could be claimed that the equipment of the three schools constituted a test sample, but the sample was too large. Equipping three entire schools, intended for 1,500 students, with furniture which may, or may not, fulfil its educational brief or stand up under classroom conditions, is a wasteful way of testing furniture. Testing should have been done on a much smaller sample of furniture - not more than 30 to 40 examples of each item.

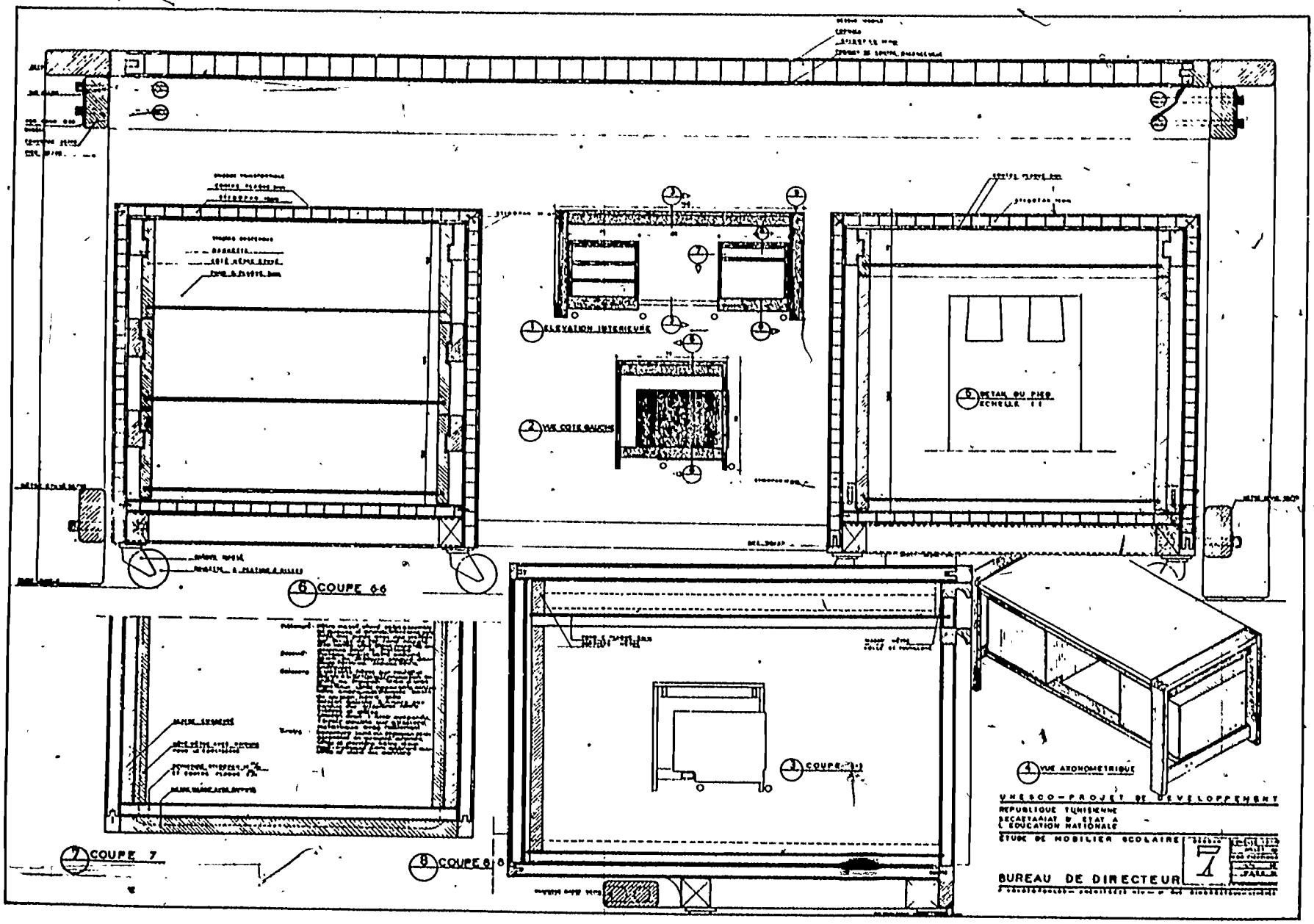
There was no quality control of the final article. The furniture delivered to the three schools was of variable quality. This was due to two administrative failings:

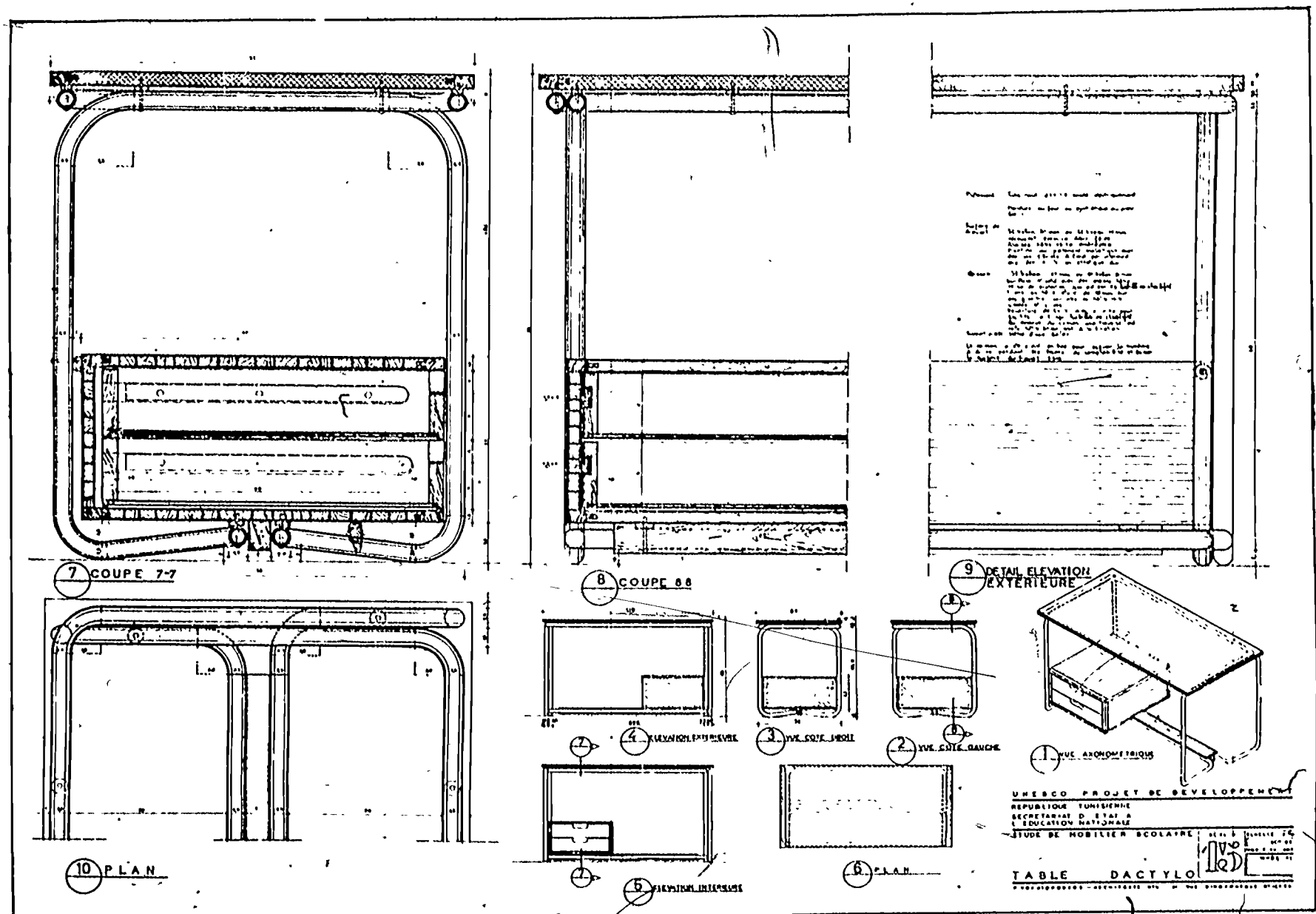
lack of quality control at the factory;
lack of a recognized procedure for the reception of furniture at the schools.

These failings will be remedied in the future by the Ministry of Education who are hiring two technicians - one an expert in wood, the other in metal. These two men will travel to schools to check the quality of the furniture when it arrives.

Another problem was that the furniture designer, designated by Unesco, was given very little time - only three months - in which to complete the work. Because of this, the study was a limited one. Noticeboards, pinboards, chalkboards and the means to display charts - important items in the equipment of a school - did not form part of the study. Equipment for the amphitheatres and gymnasiums was also left outside the study.

Furthermore many of the items of furniture did not conform to the original specifications and drawings. The furniture was put out to competitive tender but the firms that won the contracts were small and badly equipped, with few trained technicians - they were not the firms that made the original prototype furniture during the design stage.


ELEVATION INTERIEURE
VUE COTE GAUCHE
DETAIL DU PIED
ECHELLE 1:1
COUPE 6-6
COUPE 7
COUPE 8-8
VUE AXONOMETRIQUE
UNESCO - PROJET DE DEVELOPPEMENT
REPUBLIQUE TUNISIENNE
SECRETARIAT D'ETAT A L'EDUCATION NATIONALE
ETUDE DE MOBILIER SCOLAIRE
BUREAU DE DIRECTEUR
7
1


7 COUPE 7-7
8 COUPE 8-8
9 DETAIL ELEVATION EXTERIEURE
10 PLAN
4 ELEVATION EXTERIEURE
3 VUE COTE DROIT
2 VUE COTE GAUCHE
1 VUE AXONOMETRIQUE
5 ELEVATION INTERIEURE
6 PLAN
UNESCO PROJET DE DEVELOPPEMENT
REPUBLIQUE TUNISIENNE
SECRETARIAT D ETAT A L EDUCATION NATIONALE
ETUDE DE MOBILIER SCOLAIRE
TABLE DACTYLO

Case Study of a Project to Produce a Range of Furniture for Educational Establishments in the United Kingdom

The Secretary of State for Education and Science and the Secretary of State for Wales include in their responsibilities the setting of minimum standards of educational provision, the determining of the rate, nature and cost of educational building, and the training and supply of teachers. Central Government does not run any schools or colleges or appoint teachers, or prescribe textbooks or curricula. Thus, the responsibility of providing educational service belongs to the over one hundred Local Educational Authorities in England and Wales.

It was thought that if several Local Education Authorities combined for the purpose of schoolbuilding, they would stand to benefit from the economic advantages offered by bulk buying and design standardization. As a step toward this goal the Department of Education and Science encouraged the grouping of a number of LEAs in consortia. The first of these consortia was the Consortium of Local Authorities Special Programme (CLASP) which brings together over 30 LEA's and has its own industrialized building system. A feature of the consortia is the close collaboration with manufacturers to produce standardized building components - windows, doors, roof decks etc. These components are designed to exploit the manufacturers' production technique to the utmost, in order to improve performance and reduce cost.

As a general rule, the consortia's architects make drawings and specifications for building components. Contracts are then opened to competitive tender, component by component. The total number of items to be produced is known in advance, based on the building programmes of the LEA's grouped in the consortia and this results in economies of scale. The contract is usually awarded to the manufacturer placing the lowest tender. After the award of the contract, the design of the components is further refined by the architect in collaboration with the manufacturer, usually resulting in further cost saving and production efficiency. When the architects attached to the LEAs which form the consortia design individual buildings, they use the consortia's kit of pre-designed parts, thereby effecting a considerable saving of design time. But even more important, encouragement of school building consortia by the DES has actually resulted in better designed buildings produced more quickly.

Prior to the forming of school building consortia, furniture was ordered by the LEAs individually from manufacturers' catalogues. In other words, the manufacturers alone were responsible for design. The Inner London Education Authority, with its extensive building programme, was one of the few authorities to have its own design department. As it happened, manufacturers' designs were not always what was required by the LEAs. The LEAs, buying at the lowest price, were often forced to buy furniture items for a single school from a whole range of different manufacturers, leading to an unco-ordinated assembly of furniture of differing design, material and colour. At about the time the building consortia were set up, in the late fifties and early sixties, the manufacturers' ranges of furniture were becoming obsolete. Educationists were finding that the development of freer, more informal teaching methods was inhibited by existing furniture. Desks could not be grouped together because of sloping tops, penrails and lids and a simpler, more versatile solution to classroom furniture was required. Furthermore, research in anthropometry suggested that the sizes and heights of existing manufacturers' furniture were incorrect.

Given this situation, and mindful of the new concept of collaboration through consortia, the DES decided to encourage the LEAs to draw up their own designs. The first school furniture consortium was the Counties Furniture Group (CFG), founded in 1962. It was hoped that,

grouped into furniture consortia, LEAs would enjoy similar advantages to the school building consortia. That is:

prices could be reduced by bulk ordering
the LEAs could get exactly the kind of furniture they required in terms of general design and anthropometric standards
the consortia could ensure the co-ordination of the design, materials and colour for an entire range of furniture
through advance ordering for bulk purchase, the manufacturer could achieve economies by anticipating the demands on production and materials.

To give a design lead to furniture consortia and to encourage the furniture industry to be responsive to the needs of changing educational methods, a joint central and local government organization was set up to produce a range of school furniture. The latter, which came to be known as the "Forme" range, was to be offered initially to interested members of the CLASP building consortium. The case-study that follows deals with this project.

AIMS OF THE PROJECT

The over-all aims of the project were:

To demonstrate to the LEAs the advantage of the consortia approach to school furniture, and more specifically to show that if the quantity of school furniture ordered is large enough, not only can costs be reduced through bulk buying, but LEAs can themselves control design, instead of being forced to accept ready-made designs imposed by the manufacturer.

To improve the standards of school furniture on a national scale in terms of design and adaptability to current educational methods. To introduce an interchangeable range of furniture for schools, co-ordinated in relation to design, materials and colour.

To encourage co-ordinated dimensions for school furniture in line with prevailing ideas on ergonomics and education.

To produce a range of furniture that would allow continuous revision and addition as new needs arose and as new techniques of production developed.

GROUNDWORK AND DESIGN FACTORS

Since the DES has an advisory function and, unlike the consortia, has no purchasing power in relation to school furniture, it was obliged to act in a different way from the consortia. It therefore joined forces with the Property Services Agency, Supplies Division of the DOE (Department of the Environment), which took on responsibility for all contractual arrangements and the control of specification and quality with the chosen manufacturer. The DOE Supplies Division represents the largest purchasers of furniture in the UK; it is responsible for equipping a large range of government buildings including hospitals, police stations and government offices.

The DOE in turn nominated a non-governmental manufacturing firm, Pel Ltd., of Oldbury near Birmingham, to develop the required range of furniture. Pel was itself chosen as the result of a selection exercise limited to those firms capable of satisfying the following conditions:

ability to manufacture and market the entire range of furniture to specification (the contract was not to be fragmented between several manufacturers in order to simplify the future development of the range);
certain conditions of financial stability;
willingness to expand the range after the initial contract.

The manufacturing firm was to market the furniture in the ordinary way under the trade name of "Forme" with the DOE receiving royalties of one per cent on all sales. It was agreed the furniture could be sold commercially to private individuals and organizations outside the government. Pel now has an annual output of approximately £2 million of "Forme" furniture, which is expanding. Forty-nine per cent of its entire output of furniture is school furniture, or furniture suitable for schools. Very little of this output is exported; the firm prefers to export components and techniques for assembly under licence, rather than actual furniture items. In all, Pel employs 600 production workers, with 50 administration and management staff and has its own design department with two designers.

The CLASP Building Consortium was approached as an initial outlet for the sale of the furniture range, and with a view to field trials of the furniture in schools. This was a most valuable arrangement in order to launch the new range. Now however, the furniture is bought independently by a large number of LEAs, in addition to regular CLASP members.

At the outset it was necessary to see that project furniture conformed to dimensional standards and a system of colour coding laid down by the British Standards Institute.

Standards governing school furniture are established by BSI committees on which Central and Local Government, industry users and research bodies are represented. First introduced in 1950, these are under regular review. The BSI is an autonomous agency which draws up standards for dimensions, performance testing, definitions of terminology and codes of practice

in Great Britain. Its Standard Specifications (BSSs) cover a large variety of items - the size of paper, the design of bridges, cups of tea, etc. The Institute has its own mark, the 'kite', which can be stamped on articles confirming to BSSs and it employs a team of inspectors who see to it that the mark is used correctly.

The BSI is a member of the International Standards Organization (ISO) which issues international standards and groups most of the various national standards organizations.

At the start of the Forme project, BS 3030 dating from 1959 was in operation. But with the introduction of the metric system in Britain, standards had to be changed from imperial to metric measures. A new British Standard for tables and chairs was accordingly published in 1972 as BS 3030, Part 3 (Metric Units). Since BSSs are not usually mandatory, a BSS must be based on a consensus of opinion, if it is to possess the necessary authority. Thus, a wide range of manufacturers, and teachers, and their representative organizations, were consulted in the preparation of BS 3030.

At the same time it became necessary to assess the physical characteristics of furniture users, and this task was entrusted to the Furniture Industry Research Association. FIRA is a furniture manufacturers' organization, financed in the main by member firms, but also receiving government grants. It undertakes work that manufacturers are too small to tackle individually - the testing of the properties and performance of furniture, research into materials and manufacturing methods etc. It also runs an advisory service and a technical library, with a full-time staff of 26.

FIRA was commissioned by the DES to undertake a series of anthropometric research projects covering the 3 1/2 to 18 year-age range. It made a survey of 12 basic body measurements of the British school population. These body measurements were studied in relation to school activities involving furniture and equipment. The results of this work are published as Building Bulletin 38, 'Standing and Reaching'; Building Bulletin 44, 'Furniture and Equipment Dimensions'; Building Bulletin 46, 'British School Population Dimensional Survey, 1971', and Building Bulletin 50, 'Working Heights and Zones for Practical Activities'.

FIRA was paid by the DES for these studies; as an example of the sort of fee involved, Building Bulletin 46, 'British School Population Dimensional Survey 1971', cost approximately £3,000 and required the services of a full-time researcher for 15 months. FIRA was also involved in the elaboration of tests for the mechanical resistance and durability of chairs, tables and carcase work. The results of this work are the subject of a BSI standard now in draft form.

Photograph by courtesy of Pel Ltd.

Originally, the Forme range[1] was based on the needs of primary and middle schools. However, during the last five years the range has been extended upwards to meet common needs in secondary schools, and downwards to meet the needs of children of nursery school age. As to the furniture offered in the catalogues, it includes over 150 items: nursery items, tables of all types, trolleys, worktops and associated storage trolleys, special purpose trolleys for storage and display, easels and screens, rostra, space divider and storage units, seating, and wall-mounted items for storage and display.

The designs were arrived at bearing the following educational criteria in mind:

The students' work-place should not always be a base for the storage of personal belongings;
It should be possible to use tables from all sides;
Tables should be dimensioned so that they can be grouped to form large flat working surfaces. The width of the table top should be half the length;
Work surfaces are required for light and clean activities as well as for heavy and dirty activities;
Work surfaces are required at sitting height and at standing height;
Work surfaces need to be supplemented by items for storage and display;
Furnishing the walls is as important as furnishing the floors.

1. A range of six chairs conforming to the BS 3030, had already been manufactured by Pel Ltd. but these, together with all other aspects of seating, were outside the terms of the contract with the DOE.

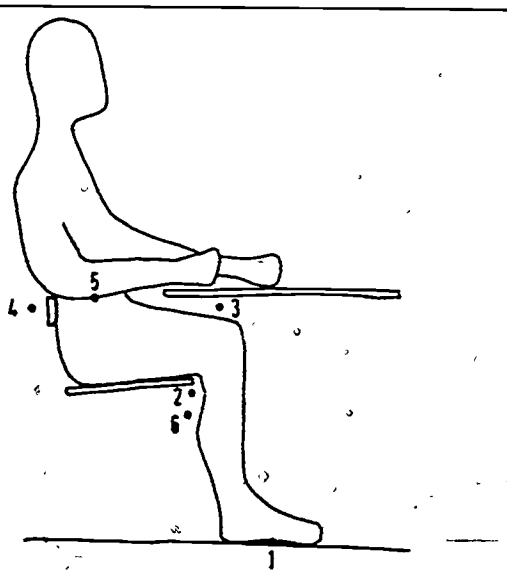
Furniture should be easy to move; furniture fixed to the building structure should be kept to a minimum.

Furniture is for adults as well as for children. Since teachers and helpers work closely with children they are not always stationed at their desks. Schools are increasingly used to serve the adult community for educational, social, recreational and cultural purposes.

Furniture should be designed within a clearly specified gamut of dimension, material and colour, in order to ensure that any selection from the range, and any rearrangement of furniture in use, can be made in a way that combines flexibility with visual harmony.

Furniture should be designed on an engineering basis to exploit new technology in metal, plastics, veneered coreboards and finishes, and to combine large-scale production with high quality and economy.

As far as the fit of school tables and chairs is concerned, a good fit is based on the simultaneous satisfaction of the six points shown in the diagram:



1. feet flat on floor
2. no pressure between seat and underside of thigh
3. clearance between leg and underside of table top
4. back in contact with backrest below shoulder blades
5. elbow nearly level with table top
6. clearance between back of leg and front of seat

To satisfy these conditions a range of six sizes of furniture was made, covering the three-and-a-half year old to adult age-groups(1).

(1) The basic authropometric criteria for the design of the Forme range can be found in DES Building Bulletins, Nos. 16, 38, 44, 46, 50 and in BS 3030, Part 3, 1972.

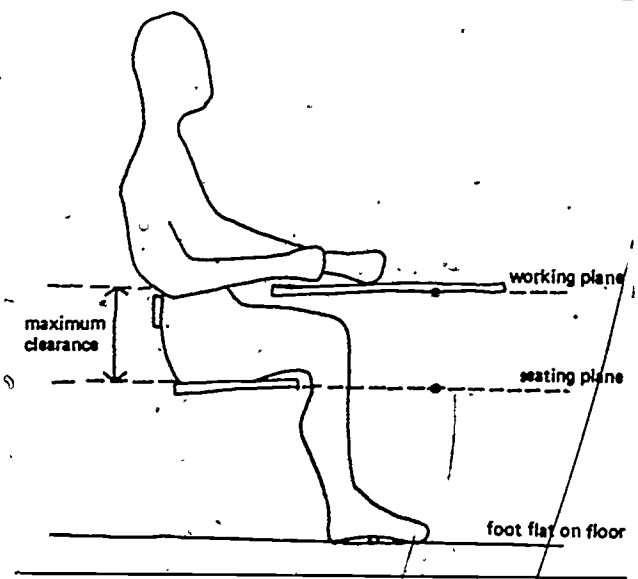
The table and chair heights chosen were as follows (in millimetres):

Code	Table Height	Chair height
N	450	240
A	500	280
B	550	320
C	600	355
D	650	390
E	700	430

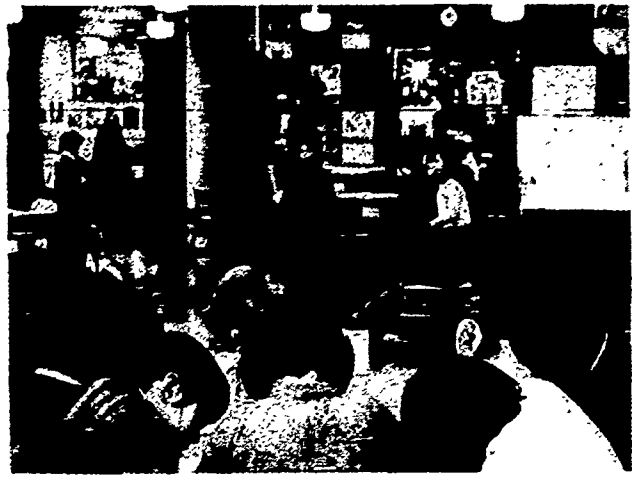
School children no longer spend all their day sitting - listening or writing. Children, during their work, are constantly moving between different parts of the school and from place to place within a space. Children no longer permanently occupy one workplace using it as a 'base' for their personal belongings. Not all children, at one time occupy or need to occupy a workplace of the same kind. That is, it is not necessary to provide as many tables and chairs as there are children in a space.

Because of this, research has now been initiated to establish new fitting criteria. These criteria will put the emphasis on flexibility and permissible 'misfit' rather than on the 'good fit' of the existing standards; they are likely to simplify recommendations and reduce the number of sizes. They will also simplify the distribution of sizes within a school and simplify the organization of production at the factory.

New fitting criteria will depend on a compromise between three points: the working plane, seating plane and the position of the foot on the floor. The diagram below illustrated these new criteria.



Informal group activities



Small group activities

The entire process, from the inception of a design through to production, entails the steps listed below:

(i) An item is selected for development.
(ii) The design drawings are made, using DES data on desired educational performance and FIRA data on anthropometry.
(iii) A prototype is "mocked up". The mock-up is composed of materials that are not necessarily the materials of the final design - fibreglass replaces polypropylene for chairs, "plastic" drawer units may be made of wood. The mock-up is examined and assessed. Finally, when the configuration of the mock-up has been agreed upon, a prototype in the intended materials is examined and tested.
(iv) A preliminary cost estimate is made, based on past experience with similar models.
(v) A production line is set up and items are produced. Stringent factory tests are performed which go beyond the recommendations of BSS 3030 for testing. For certain items - chairs, plastic liners for supporting plastic trays - extensive testing may be required to determine the life span of the article.
(vi) Adjustments are made to production machinery and techniques.
(vii) After approval by the DES and the DOE, final production begins.

It should be noted that furniture is not tested before production under school conditions: tests in the factory are designed to simulate, in a short time, several years of use in schools.

It can be seen that manufacture and design are part of a continuing process. Experience shows that the time taken from inception to final production varies from 6 months to two years depending on the priority given to the article and its complexity.

Because it is designed to be flexible, the Forme range of furniture is well suited to the needs of primary schools. However, this flexibility is not always fully exploited. Some teachers seem unaware of the different arrangements possible. For example, many mobile cupboards tend to stand in one place permanently; the cork bulletin board provided on the back of the mobile storage units for low level display is rarely put to use and although chairs and tables can be stacked, in practice this is rarely done.

On the other hand, no guide to its use is issued with the furniture because of the multitude of different circumstances surrounding its function in old as well as new schools. But Pel does make sets of model furniture to 1:20 scale that can be used on scale drawings to explain different furniture layouts. These are not cheap at £350.00 a set, but 7,000 models of pieces of furniture have so far been made and there is a constant demand.

Though they are not a part of the Forme range, shell chairs - a single moulded plastic element forming seat and backrest mounted on steel legs - have a strong aesthetic appeal, and many LEAs are ordering them. It would seem that most shell chairs do not satisfactorily support the body in writing postures. Generally, shell chairs do not permit the individual to adopt a forward leaning posture while simultaneously maintaining contact between the backrest and the lumbar region of the back. However, the backrest of a shell chair can flex backwards, an attribute suited to the relaxed position adopted in auditorium seating. It would nevertheless seem possible to design a shell chair permitting good upright writing position in accordance with BS 3030, Part 3.

In this connexion, it should also be mentioned

that in 1972 there were about 1,000 fires in day school buildings in Britain, a third of which were due to malicious fire raising. The fire properties of plastic chairs are the subject of research at the Rubber and Plastics Research Association (RAPRA) carried on in collaboration with the DOE Fire Research Station. A report on the toxicity of plastics is being written by the Porton Medical Centre and the Greater London Council (GLC) Supplies Department is experimenting with fire on polypropylene chairs. None of this research has yet been published.

Untreated polypropylene chairs are easily ignited. Polypropylene chairs treated with fire-retardant are less easily ignited, but, once alight, they will produce more smoke and toxic fumes. Fire-retardant also tends to impair the flexibility and strength of the material. The problem facing the manufacturers is the delicate balance to be achieved between flexibility, strength and fire resistance. It should also be borne in mind that if a stack of chairs is set alight fire will spread down the stack, because the plastic drips just as easily as it spreads up.

Most new furniture items are made with techniques and materials already in use in the firm's existing production. As a result, a correct estimate of the cost of an item at the design stage will depend on a thorough knowledge of the exact cost of items already in production. Cost is based on: the cost of materials; operational costs; administrative costs and profit.

Profit, expressed as a return on capital employed, is resolved annually between Pel Ltd., and the DOE, but within this limit it is Pel's responsibility to ensure that their prices are competitive with those of other manufacturers for similar articles.

The colour coding of tables and chairs has been introduced to ensure that the right size table is used with the right size chair. Further, the colour can be indicated in the form of a mark, or entire elements - table tops, seats, etc. - can be coloured to permit easy recognition. Again, it is worth drawing attention at this stage to the numerical coding of furniture items introduced by DOE P.S.A. Supplies Division. It is their own system and does not form part of any BSI recommendations. Its major appeal is that it constitutes a quick shorthand way of describing furniture; the code number, 02.66 4832, for example, does service for the words "table with two end cupboards, table top 1500 x 900 mm, height 600 mm with beech veneer top". Such coding of furniture is essential if the furniture inventory is to be kept in a computer data bank or if a computer is to be used in the ordering of furniture. So far as is known, computers are not used by any LEA for furniture inventories or ordering; only the DOE makes use of computers for this purpose.

PRODUCTION METHODS AND MATERIALS

Table tops are made of chipboard, finished with either linoleum, plastic laminate, beech veneer or oil-tempered hard-board for practical work. Lipping is composed of an extruded PVC section, cut to size, welded into a loop, heated and shrunk onto the table as it cools. The top of the table is supported by a continuous rail of steel angle or rectangular tube, legs are light steel tube, and assembly is by welding.

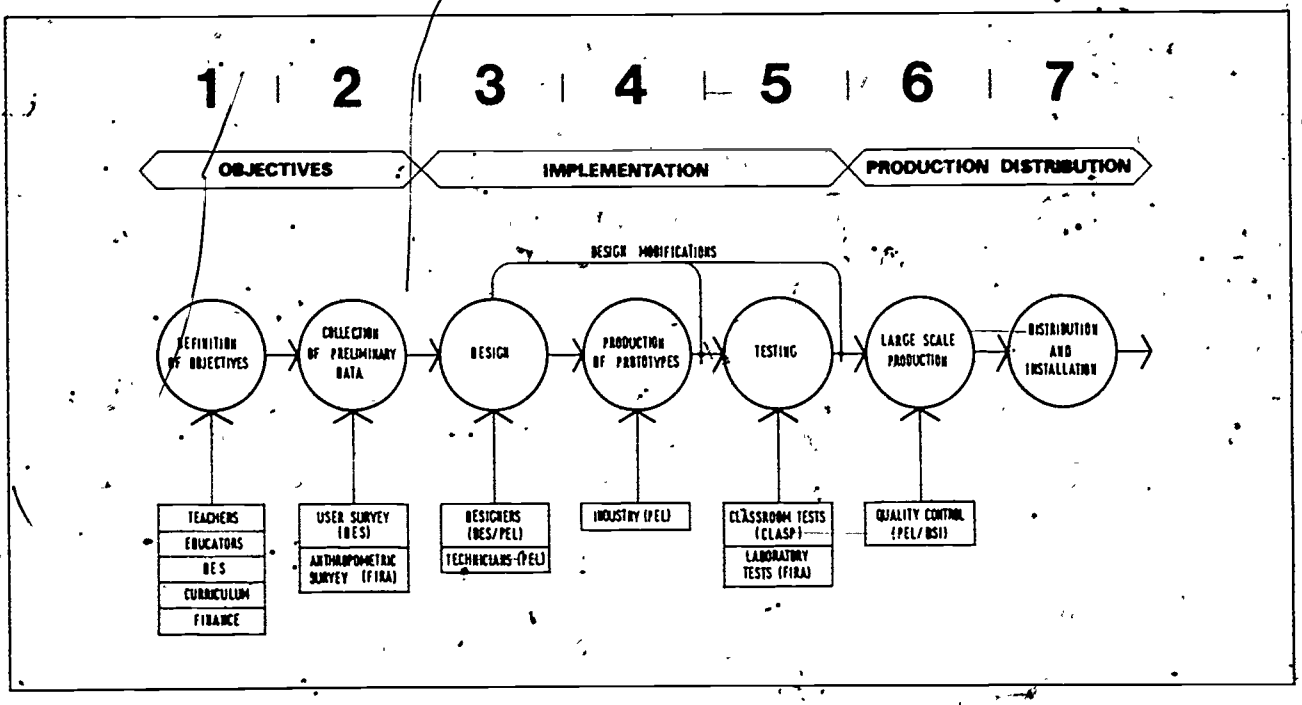
The seat and backrests of chairs are of polypropylene injection mouldings. The moulds are expensive, about £8,000 each. In cost terms, the solution of a separate backrest and seat possesses advantages over the shell chair combining seat and backrest. Moreover, the smaller moulds for the separate seat and backrests are cheaper and require a smaller machine for the injection process. Only four sizes of seat and backrest are needed to cover the complete range of six chair sizes; for instance, one size of seat and backrest is used for two types of chair and the difference in size can be brought about by altering the framework. The components connecting the seat to the backrest are of pressed steel which in turn gives a certain amount of resilience to the backrest. The weight of the seat is transmitted to the legs of the chair through plastic bushes underneath the seat. The legs themselves are light steel tube fitted with high/low blend polythene inserts.

Carcasses are generally constructed from chipboard, and lipped and veneered in beech. Divisions and shelves are beech-faced plywood. ABS liners are bonded to divisions to support shelves and plastic trays. Tops are constructed in the same way as table tops. Castors are rubber or nylon wheeled but without locking devices. Backs are either made from beech-faced ply or covered with cork bulletin board. Doors are chipboard lipped and veneered in beech while ironmongery and fittings are either steel or plastic. Wooden elements are curtain-coated with acid catalyst lacquer before assembly.

The Pel factory batch-assembles furniture. Batches of furniture components are formed into furniture items at a fixed assembly position. But with the exception of the curtain coating process for wood finishing, and the epoxy powder coating process for finishing the steel frames, there is no moving assembly line as in a car factory.

In making the chair, the following component parts are called for:

two light steel tube legs
two pressed steel frames connecting the seat and legs to the backrest
one polypropylene seat
one polypropylene backrest



two plastic bushes for spreading the seat load over the legs
four blended plastic inserts for the chair legs
two nylon seat fixing rings which permanently secure the seat, giving a maintenance-free assembly
two nylon rings for fixing the backrest and indicating the colour code.

As a result of the production process:

the steel elements are cut to size
the pressed steel elements are formed in pairs by a progressive tooling system with four separate pressing operations; burrs are removed from each component individually by a hand finishing and mopping operation.
the tubular legs are formed in a press three at a time, by a single operation of the press which produces three legs, each leg with four bends in it. Front and back legs are produced separately as their form differs
all the steel components are brought to the welding stations where the pressed steel components are C02 welded to the tubes
the frame is set to a master pattern to ensure consistency of the product and that it stands square
the frame is cleaned, degreased and sprayed electrostatically, using oven-cured epoxy powder. This entire process is continuous
the frames are then stacked for seat and back assembly. Plastic inserts are fitted to the legs, and protective sleeves keep the frame clean and give additional protection during handling and transport. The polypropylene seats and backrests are fitted
after assembly the chair is checked once more for any defects, and packed.

Furniture is produced by the factory in response to orders received. For cost reasons, little furniture is kept stocked at the factory itself. As soon as it is completed, furniture is sent to the schools or schools providing the order. Since items are produced in batches - the factory does not make the whole range of furniture on a continuous basis - the furniture is sent off in batches and orders are usually effected by more than one delivery to each school. This can lead to confusion at schools, especially when consignments of furniture are received over a long period of time. It must be remembered that the furniture was not designed with transportation in mind. Furthermore, not enough units of furniture can be stacked in each delivery van, and this adds to delivery time. Furniture prices include the cost of delivery and off-loading. Since the Pel factory is centrally placed in the UK, delivery distance is never more than 500 miles, so that a fixed price can be quoted to all purchasers. For the peak delivery period of June, July and August, extra vehicles are hired by the manufacturer. The positioning of the furniture within the school is the responsibility of the LEA. The LEA is also responsible for the acceptance and security of furniture delivered prior to a school opening. In the normal way, furniture delivered to a school site is accepted by a site representative who limits himself to checking for quantity.

OVERVIEW

The diagram on the previous page gives a simplified graphic representation of the research and development process followed throughout the project.

The project has done much to encourage the 'consortia approach' to school furniture supply, that is, a large purchasing organization that develops its own designs to suit the needs of teachers and learners, and works closely with manufacturers to reduce costs.

The furniture itself is bright, attractive convenient and can be moved easily. It works best in primary schools since, in general, secondary schools are not ready to exploit the flexibility of the range.

However, one problem which has not been solved is that of the smooth supply of furniture to schools. Usually, furniture arrived at new schools in consignments spaced out over several days, with the last consignment often arriving after school has begun. Also teachers are for the most part unaware of the different arrangement possibilities of the furniture range. They fail to exploit its mobility and additional ways of explaining the possibilities of the furniture to them should be found.

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APPENDIX I

Tunisia

THE CONSULTANT'S TERMS OF REFERENCE

The Consultant, acting upon the instructions of the Director-General of Unesco, shall:

Undertake a study of school furniture in connexion with the project to construct secondary schools for girls in Tunisia. In this connexion the Consultant will study the contract documents for the construction of the secondary boarding school for girls at Béja.

To be carried out in close collaboration with the interested authorities at the Tunisian Ministry of Education and the Educational Facilities Section of Unesco, the study will include:

(a) a visit of about 10 days to Tunisia to make contact with the interested authorities and to make a qualitative and quantitative survey of existing furniture used in schools, of conditions under which school furniture is produced and, in particular, of the local industrial resources and the possibilities of adapting and/or establishing a school furniture industry;

(b) research into documentation on school furniture studies in other countries;

(c) recommendations for improvements that could be made to existing furniture;

(d) study of economic considerations and anthropometric and educational requirements. This study will include:

the definition of criteria to which items studied should comply in connexion with design and factory production (particularly easy repair of different items of furniture),

detailed drawings of each item covered by the project, giving suggestions for alternative materials (e.g. light-weight steel tube, wood, etc.),

a specification and cost analysis of each item in each of the alternative materials suggested,

a study of the amortization and maintenance costs of the proposed furniture;

(e) a period of supervision over the construction of prototypes for each item.

The different items of school furniture to be designed are: table, chair, storage unit, bedstead with wardrobe and all items required in general classrooms, equipment for specialist rooms, laboratories, workshops, boarding accommodation and in general any other furniture which may be used in secondary schools.

The Consultant will submit a final report, comprising a resumé of the project, a critical evaluation of the completed prototypes and recommendations for factory production.

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APPENDIX II

Tunisia

FURNITURE EVALUATION SHEET FOR STUDENTS' DESKS AND CHAIRS

Etablissement:

Nom:

Poste:

TABLE 2 PLACES

	oui	non
Dimensions - Largeur, Longueur, Hauteur satisfaisantes	☐	☐
Mobilité facile	☐	☐
Groupage réussi	☐	☐
Polyvalence valorisée	☐	☐

	Bonne	Mauvaise
Solidité générale - Bonne, Médiocre, Insuffisante Fixation - Bonne, Médiocre, Insuffisante	☐	☐
Parties détruites en général - Piétement, Dessus, Porte-livres	☐	☐
Résistance à l'usure - Piétement, Surface travail	☐	☐
Couleur - Piétement, Surface travail	☐	☐

Eléments à éliminer

Suggestions personnelles

CHAISE D'ELEVE

	oui	non
Dimensions - Largeur, Longueur, Hauteur satisfaisantes	☐	☐
Mobilité facile	☐	☐
Stockage facile	☐	☐
Bruit excessif	☐	☐

	Bonne	Mauvaise
Solidité générale - Bonne, Médiocre, Insuffisante Fixation - Bonne, Médiocre, Insuffisante	☐	☐
Parties détruites en générale - Piétement, Siège, Dossier	☐	☐
Résistance à l'usure - Piétement, Parties bois	☐	☐

Suggestions personnelles :

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Spain	*All publications:* Ediciones Iberoamericanas, S.A., calle de Oñate 15, MADRID 20; Distribución de Publicaciones del Consejo Superior de Investigaciones Científicas, Vitrubio 16, MADRID 6; Librería del Consejo Superior de Investigaciones Científicas, Epigrafes 15, BARCELONA. *For 'The Courier' only:* Ediciones Liber apertado 17, ONDÁRROA (Vizcaya).
Sri Lanka	Lake House Bookshop, Sir Chittampalam Gardiner Mawata, P.O. Box 244, COLOMBO 2.
Sudan	Al Bashir Bookshop, P.O. Box 1118, KHARTOUM.
Sweden	*All publications:* A/B C.E. Fritzes Kungl. Hovbokhandel, Fredsgatan 2, Box 16356, 103 27 STOCKHOLM 16. *For 'The Courier':* Svenska FN-Förbundet, Skolgränd 2, Box 150 50, S-104 65 STOCKHOLM.
Switzerland	Europa Verlag, Rämistrasse 5, ZÜRICH; Librairie Payot, 6, rue Grenus, 1211 GENÈVE 11.
Tanzania	Dar es Salaam Bookshop, P.O. Box 9030, DAR ES SALAAM.
Thailand	Suksapan Panit, Mansion 9, Rajdamnern Avenue, BANGKOK.
Togo	Librairie évangélique, B.P. 378; LOMÉ; Librairie du Bon Pasteur, B.P. 1164, LOMÉ; Librairie moderne, B.P.777, LOMÉ.
Turkey	Librairie Hachette, 469 Istiklal Caddesi, Beyoglu, ISTANBUL.
Uganda	Uganda Bookshop, P.O. Box 145, KAMPALA.
U.S.S.R.	Mezhdunarodnaja Kniga, MOSKVA, G-200.
United Kingdom	H.M. Stationery Office, P.O. Box 569, LONDON SE1 9NH; Government bookshops: London, Belfast, Birmingham, Bristol, Cardiff, Edinburgh, Manchester.
United States	Unesco Publications Center, P.O. Box 433, New York, N.Y. 10016.
Upper Volta	Librairie Attie B.P. 64, Ouagadougou, Librairie catholique 'Jeunesse d'Afrique', OUAGADOUGOU.
Venezuela	Libreria Historia, Monjas a Padre Sierra, Edificio Oeste 2, n.° 6 (frente al Capitolio), apartadode correos 7320-101, CARACAS.
Yugoslavia	Jugoslovenska Knjiga, Terazije 27, BEOGRAD. Drzavna Zalozba Slovenije Mestni Trg. 26, LJUBLJANA.
Zaire	La Librairie, Institut national d'études politiques, B.P. 2307, KINSHASA; Commission nationale de la République du Zaïre pour l'Unesco, Ministère de l'éducation nationale, KINSHASA.